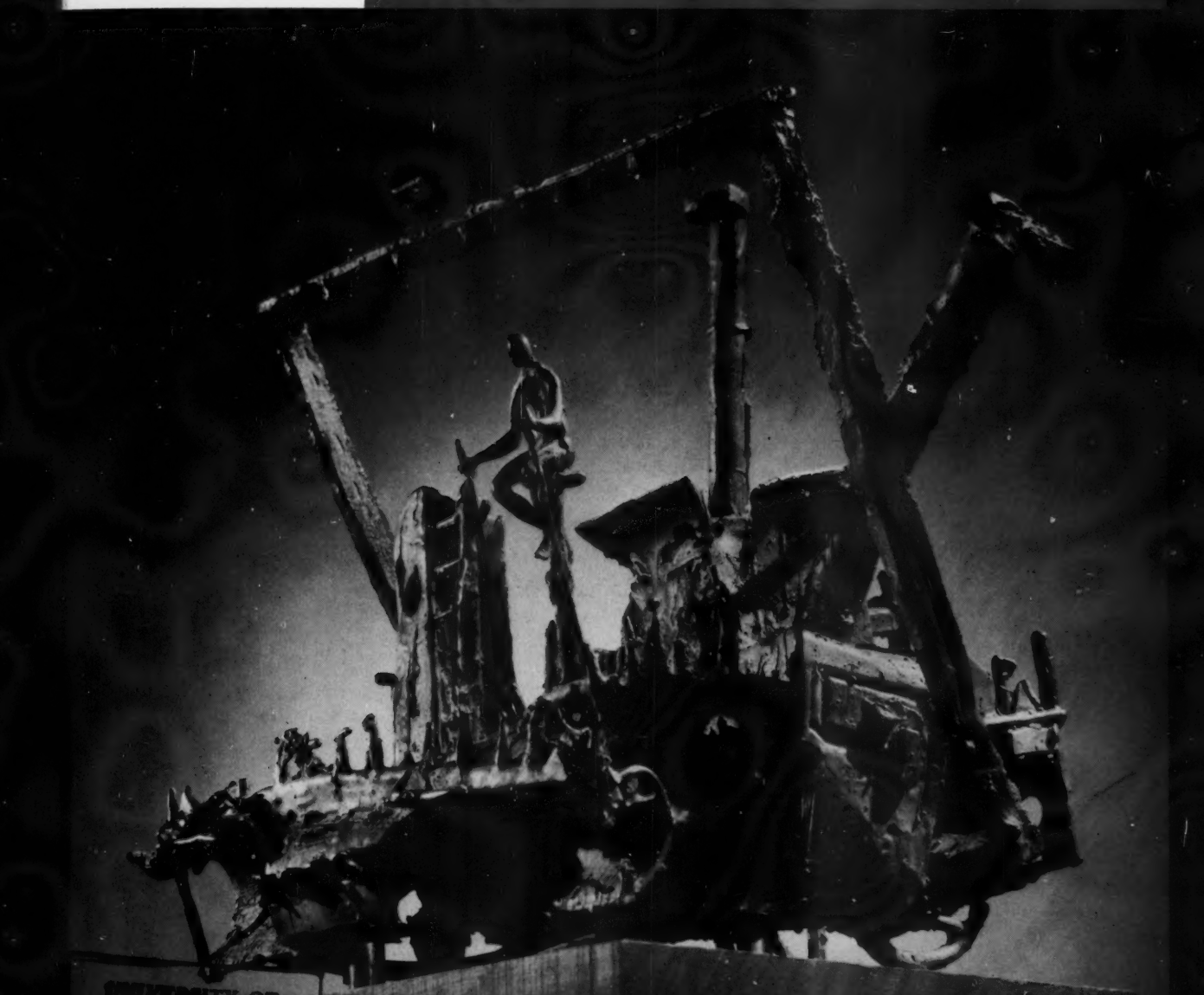
CEREAL SCIENCE today

35c PER COPY

SEPTEMBER 1956 VOLUME 1 • NUMBER 3



UNIVERSITY OF BRITISH COLUMBIA
AUG 29 1956
THE LIBRARY

AN OFFICIAL PUBLICATION
AMERICAN ASSOCIATION
OF CEREAL CHEMISTS

OF INTEREST THIS MONTH

AUTOMATION IN FEED MILLING
CHEMICAL ADDITIVES IN FOODS
PACKAGING OF CEREAL PRODUCTS

6th Edition

CEREAL LABORATORY METHODS

COMPLETELY REVISED AND REORGANIZED

Any discussion of this world renowned book has to be directed to two separate groups — those unfamiliar with earlier editions and those who regularly use this volume in their laboratory as a standard methods source.

To the former group it should be pointed out that CEREAL LABORATORY METHODS has been published by the American Association of Cereal Chemists since 1922. It represents the work of cereal chemists employed in industrial, academic, and government laboratories throughout the world. It contains the accepted analytical methods used by these chemists for determinations on cereal or cereal by-products.

Former users will be interested in learning that the new 6th edition will be some 40% larger than the 1947 volume and that over 50% of it will be new and/or revised material. The most significant change will be the new style of presentation. No longer will the book be divided into chapters, each concerning a particular subject such as wheat, bread, flour, feed, etc. Instead, the 6th edition will be divided into 100 categories consisting of "determinations" such as the determination of acids, of amylase activity, of calcium, of moisture, of fat, etc. Each of these major categories will be further divided into specific tests.

Many new methods have been included in the 6th edition which were not available in 1947. Among these are methods for the testing of prepared mix ingredients, of physical properties of doughs, of bread staling, etc.

The 6th edition of CEREAL LABORATORY METHODS has been designed for easy use in the laboratory by both the chemist and technician. Ample details are provided for the preparation and standardization of all solutions. Apparatus and equipment are clearly described and special items are accompanied by name of manufacturer. The two separate indices are designed to provide quick access to any method in the book.

PRICE
$11:00
per copy

PUBLICATION DATE
FALL 1956

SEND YOUR ORDER TO:

AMERICAN ASSOCIATION OF CEREAL CHEMISTS
University Farm, St. Paul 1, Minnesota

A New Chapter In
The Vital Story of Bread Enrichment

by Science Writer

Lighting 15 Candles

1956 is a milestone in the trend to nutritional improvement of processed foods. It marks the 15th Anniversary of white bread and white flour "enrichment" in the United States.

Back in the late 1930's millers and bakers began the restoration of vitamin B_1 to their foods. Later vitamin B_2, niacin and iron were included. Then in 1941 the concept of "enrichment" came into being: restoration of B_1, niacin and iron and fortification with a *higher* amount of B_2 than originally present in the wheat berry.

The baking and milling industries deserve the gratitude of the nation for thus insuring better foods for the nation's better health.

What Diet Experts Say

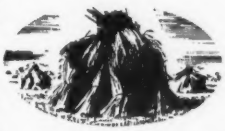
Physicians, dietitians, nutritionists, public health experts have supported enrichment from the start and continue to approve the practice. For example, a prominent public health nutritionist has said:

> *". . . my first and most important suggestion to you—continue not only to enrich your white bread but continue to promote enrichment until all white bread in the United States is enriched, and continue to tell the public repeatedly and more effectively about the nutritional value of enriched white bread."*

The U. S. Department of Agriculture credits the enrichment of white flour and bread for major improvements in the per capita daily food supply. Said the Department in the 1955 outlook issue of its publication "The National Food Situation"—"Enrichment and fortification of grain products continue to make an important contribution to the nutritive value of diets, especially in thiamine."

Why Enrich?

Americans want *white* bread to eat. Millers and bakers want *white* flour because it keeps better and bakes better. To produce this fine product, millers must process the grain to a high degree of whiteness—unavoidably milling out some values known to be necessary for good health.



Enrichment restores the important lost nutrients. It puts white flour and bread on a par with—in many cases actually ahead of—whole wheat products in their content of these factors which are necessary to good health and well-being:

Thiamine (vitamin B_1)	Niacin (another "B" vitamin)
Riboflavin (vitamin B_2)	Iron

What Values Do the Enriching Vitamins and Iron Have?

Thiamine is the vitamin which helps build physical and mental health. Essential for normal appetite, intestinal activity and sound nerves.

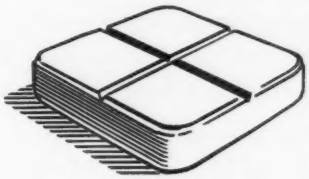
Riboflavin helps promote healthy body tissues and proper eye function.

Niacin is needed for healthy body tissues. Effective in treating and preventing pellagra.

Iron is the mineral used in enrichment. Essential for making good, red blood and in preventing nutritional anemia.

How Is White Bread Enriched?

Several methods may be used. In one, bakers use enriched white flour—flour which has been enriched at the mill according to federal definitions and standards of identity or state law.



Most bakers in the United States use a tablet or wafer. One of these contains enough thiamine, riboflavin, niacin and iron to enrich 100 lbs. of unenriched white flour—sufficient to produce 155 lbs. of white bread.

One popular form of wafer is known as "Square." Shown above in actual size, the "Square" wafer has many advantages for the baker.

Square wafers are distributed in two types by leading yeast companies throughout the United States:

Type A—for use in bread formulas requiring 3% or more non-fat milk solids.

Type B—for use in bread formulas requiring less than 3% non-fat milk solids.

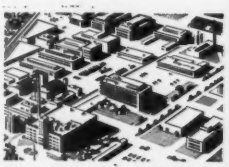
How to Identify Enriched Bread

You can't tell enriched bread by its appearance or taste. If you live in one of the 27 states having laws requiring white flour and bread to be enriched you can assume you're getting these nutritionally improved products. But all packages of enriched flour, and all wrapped enriched white bread, must show the word "enriched." Look also for a declaration on your bread wrapper similar to this:

> 8 ounces of this enriched bread supply you with at least the following amounts of your minimum daily requirements for these essential food substances: Thiamine (vitamin B_1) 55%; Riboflavin (vitamin B_2) 17.5%; Niacin (another "B" vitamin) 5 milligrams; Iron 40%.

Wherever you go, insist on bread enriched with vitamins and iron for better nutrition—for better health—for better well-being.

Vitamins Are Made



While vitamins occur naturally in foods, most vitamins used in food processing are manufactured through the marvels of chemistry and engineering. At the huge Roche Park plant of Hoffmann-La Roche they are manufactured *by the tons*. Using amazingly complex processes with scientific production controls and intricate equipment, the Roche people produce pure vitamins that are equal chemically and in biological activity to Nature's own. So efficient are these operations that the vitamins are sold at lower prices than if they were extracted from natural sources.

This article is published as a service to the baking industry by a pioneer in enrichment—Hoffmann-La Roche Inc. Reprints are available on request without charge. Write to the Vitamin Division, Hoffmann-La Roche Inc., Nutley 10, New Jersey.

THE EXTENSOGRAPH*

has been greatly improved by us:

- All dough dishes and dough clamps are "Teflonized", that is, they are covered with polytetrafluoroethylene. This is a material brought out by the du Pont Company, and its most important characteristic is that nothing will stick to it. Teflon is a very expensive material, costing about $60.00 a pound and the Teflonizing process is very laborious and time-consuming. Nevertheless, we thought that this improvement is worth all it costs.
- The dough trays in the cabinet, which receive the dough dishes during the dough aging, have been improved threefold: They are now made in two parts, which can be quickly disjointed for easy cleaning; they are painted with a water-resistant paint; they have interchangeable canvas inserts, which offer the advantage that the dough will not stick to the canvas, and therefore, will not elongate itself when the dough dish is removed from the tray for testing.
- The dough roll in which the dough is rolled to a sausage, now has a corrugated surface and is also Teflonized, like the dough dishes and dough clamps referred to above. The advantage of both corrugation and Teflonizing is that even sticky doughs will not stick to the surface and will therefore not tear during testing even when a very minimum of dusting flour is used.
- A Teflonized flexible apron is provided for the same dough roll. It is hooked onto the roller housing and the dough is rolled to a sausage or cylinder between the corrugated and Teflonized dough roll, and the Teflonized apron.
- A Teflonized dough positioner is provided, on top of the roller housing, to make certain that each dough ball falls perfectly centered into the dough roll, and to prevent that any dough cylinder comes out lopsided.
- An automatic timer switch is installed, which stops the dough rounder automatically after exactly 20 turns. The advantage of this automatic switch is that each dough receives exactly the same amount of rounding treatment, thus insuring greater uniformity of test results.
- A spindle stop switch is provided, which automatically stops the spindle movement, after its "up" travel is completed, thus relieving the operator of all attention to this while he may be rounding and rolling the dough.
- A chart paper winder is installed at the far end of the recording device upon which the paper will roll itself, thus preventing the chart paper from hanging down and possibly tearing.

* "EXTENSOGRAPH" AND "EXTENSOGRAM" ARE REGISTERED TRADE MARKS OWNED EXCLUSIVELY BY US.

BRABENDER CORPORATION **Rochelle Park, New Jersey**

Established 1938

VOLUME 1 • NUMBER 3 • SEPTEMBER 1956

CEREAL SCIENCE today

FEATURES

Automation in Feed Milling. Ward R. Flach 88
Chemical Additives in Foods. Paul E. Johnson 94
Packaging of Cereal Products. Albert V. Grundy 97

TECHNICAL SECTION

The Use of Chlortetracycline-Aureomycin in Poultry Production. Robert White-Stevens, H. G. Zeibel, and N. E. Walker 101

DEPARTMENTS

Editorial 85
Introducing the Authors 86
The President's Corner 110
Book Reviews 100
People, Products, Patter 112
Starch and Starch Products 114
A.A.C.C. Local Sections 115
"30" 116

STAFF

W. F. GEDDES, Editor-in-Chief
R. J. TARLETON, Editor and Managing Editor
C. H. BAILEY, Consulting Editor
EUNICE R. BROWN, Assistant Editor
HARLEY L. WARD, Advertising Manager
DOREEN CHRISTENSON, Circulation Manager

DEPARTMENT EDITORS
Baking Technology:
Otto G. Jensen, Oscar Skovholt
Feed and Feed Formulation:
S. F. Brockington, Loren V. Burns
Flour Milling:
R. K. Durham, H. H. Schopmeyer
Nutrition:
W. B. Bradley, Clinton L. Brooke
Sanitation:
Ross H. Cory, Kenton L. Harris
Starch and Starch Products:
Frank E. Horan, Norman Kennedy

CORRESPONDING EDITORS
AUSTRALIA: R. A. Bottomley
CANADA: L. R. Patton, H. Harms
DENMARK: Holger Jorgensen
ENGLAND: J. B. M. Coppock, C. R. Jones
FRANCE: Jean Buré
GERMANY: Paul Pelshenke
HOLLAND: G. L. Bertram
ITALY: C. Ottavio
JAPAN: Mitsuo Uemura
NORWAY: Halvor Norheim
PERU: Miguel Rafic
SWEDEN: Sven Hagberg
SWITZERLAND: L. S. Cuendet

COVER: "The Decrepit Machine," sculpture in bronze by Philip Martin, exhibited at the Walker Art Center, Minneapolis, 1956. Photograph by Gordon R. Ray

Copyright 1956 by the AMERICAN ASSOCIATION OF CEREAL CHEMISTS

CEREAL SCIENCE Today is published ten times per year (monthly except June and August) by the American Association of Cereal Chemists, from 500 South 5th Street, Minneapolis 15, Minnesota. Editorial Headquarters and Circulation Department: University Farm, St. Paul 1, Minn. Advertising Office: 360 N. Michigan Ave., Chicago 1, Ill. Application for 2nd Class mail privileges is pending at Minneapolis, Minn.

The American Association of Cereal Chemists assumes no responsibility for the statements and opinions advanced by contributors to its publications. Views expressed in the editorials are those of the editors and do not necessarily represent the official position of the American Association of Cereal Chemists.

Subscription rates: 1 year, $3.00; 2 years, $5.00; 3 years, $7.00. Foreign postage: $1.00 per year extra. Back issues available on request. Single copies: 35 cents.

CHANGE OF ADDRESS: Notify Circulation Department, American Association of Cereal Chemists, University Farm, St. Paul 1, Minn. Include both old and new addresses and postal zone number, if any.

"STANDARD of the WORLD" for gassing power determinati

The Original PRESSUREMETER

by Sandstedt and Blish

Shown below in conjunction with our

"PRESSUREMETER SPECIAL" CONSTANT TEMPERATURE WATER BATH

MANOMETER TYPE
Pressuremeter

PRICE $32.00

This is the original Pressuremeter. Mercury manometer is inherently accurate. Used in Laboratories thruout the World.

GAUGE TY
Pressuremet

PRICE $32.0

Convenient to handl
model is often used f
control and routine de
ations. Can be re-c
for accuracy against
nometer Pressuremet
use of Tester-Coupl
illustrated — see Pric
PRICE $22.00

THE "PRESSUREMETER SPECIAL"
CONSTANT TEMPERATURE WATER BATH

PRICE $184.00

shown above, complete with copper lined tank, motor agitator, Super Sensitive Controls and Relay, Heater Bulb and brass trays for 8 Pressuremeters.

TIGHTENING WRENCH
PRICE $3.00

SOCKET BASE FOR TIGHTENING
PRICE $3.00

DELIVERY FROM STOCK

CEREAL CHEMISTS' EQUIPMENT MANUFACTURER

NATIONAL MFG. COMPANY
LINCOLN, NEBRASKA

Editorial

During the past half-century the interests and activities of cereal chemists and technologists have passed through a series of cycles. Early in that period the interest was largely chemical: What constituents are present in cereals and cereal products? What changes do they undergo when converted into foods and feeds? How can they be determined most accurately? Then followed a surge of interest in physical and physicochemical techniques, certain of which measured basic properties of significance. Later, with the great expansion of researches in nutrition, the interests of the cereal chemist became intimately interwoven with those of the physiologist and nutritionist. Measurements of the nutrients in cereal foods, including vitamins and minerals, their distribution in the products of milling and other products of conversion, and their supplementation in the enrichment of finished products became the concern and responsibility of the cereal industries, and thus of the chemists who serve them. In fact, recognition of the significance of cereal products in mass nutrition and their unique fitness as a medium for supplementing essential vitamins has resulted in a new and expanding opportunity for the application of novel techniques and the evolution of large industries devoted, directly or indirectly, to the improvement of human health in large populations.

Nor has this progress necessarily ended. Various considerations, including shifts of diet patterns incidental to crop failures, international trade barriers, population increases, and other factors profoundly and increasingly affect the demand for and utilization of cereal foods. For example, the substantial shrinkage of rice exportation from the so-called "rice bowl" areas of southeastern Asia and near-by islands has caused a shortage of that cereal in certain importing countries. Already processes are in motion to expand production of rice replacements, based upon wheat, barley, tapioca, and other farinaceous foods. This affords a unique opportunity not only to supply energy foods from other sources than heretofore, in a familiar and delectable form, but to improve the nutritional value, indeed, by scientifically controlled processing, and by supplementation or enrichment. Large populations are now considering these possibilities or necessities, and others will do so.

Cereal chemists should so direct their thinking and organize their researches that they may play an appropriate role in the production of the foods involved. Thus they may make a direct contribution to the improvement of the nutrition of great populations.

C. H. Bailey
Institute of Agriculture
University of Minnesota

INTRODUCING

the authors

● WARD R. FLACH

Ward R. Flach can face up to a control panel for directing the automatic mysteries of remote-control batching of feeds—such as the one pictured in his paper—knowing what it's all about and what will happen when any button is pushed. He began work with the Eastern States Farmers' Exchange in 1929. Since 1947 he has headed the quality control section, which has given him a welcome opportunity for instigating many mechanical and electrical improvements in feed milling. One of these is the dielectric sterilizing of baled burlap bags for reuse, a revolutionary method of controlling the spread of disease which has proved 100% effective, even destroying anthrax organisms.

When not engaged in making feed, Mr. Flach likes to relax by going camping, boating, and fishing. He is a member of the Niagara Frontier Section and the American Chemical Society, and is one of the associate referees on drugs in feeds for the Association of Official Agricultural Chemists.

● PAUL E. JOHNSON

A consistent devotion to various aspects of nutrition over many years

— in education and in government service and in both civilian and military capacities — is the background for Paul E. Johnson's contribution this month about chemical additives in foods. He has been Executive Secretary of the Food Protection Committee of the National Research Council for the past two years, and his work just previous to that position was with the Tennessee Valley Authority as animal nutritionist and agriculturist from 1946 to 1954. Three years were spent during World War II as Nutrition Officer in the Army. His special bent appears as far back as his work in animal nutrition leading to the Master's degree, University of Missouri, in 1936. Then followed the Ph.D. degree in the same subject from Cornell in 1939, and work at agricultural experiment stations until 1943, at North Dakota in animal nutrition and at Louisiana in nutritional properties of horticultural crops.

● ALBERT V. GRUNDY

Experience over some 27 years has made Mr. Grundy familiar with all types of packaging and attendant problems. Born and educated in Liverpool and serving with the British

Army in World War I, he began working in 1919 for Lever Bros. in England as chemist in research and development, and later as works manager in the Belgian Congo, erecting and operating soap and oil mill extraction plants. Coming to the United States in 1926 and being employed at the Colgate Company's plant in Jersey City, N. J., as assistant plant superintendent opened the way for his specializing in packaging; he undertook this work for Colgate-Palmolive-Peet in 1929. Soon, however, he transferred to the Office of the Quartermaster General and was one of a group charged with development of packaging and packing specifications covering the 80,000 items of Quartermaster supply. With the transfer of this activity to the Chicago Quartermaster Depot, he assumed his present responsibilities as Director of the Container Laboratories of the Q.M. Food and Container Institute for the Armed Forces. He is Q.M. Corps representative on many technical, professional, and industrial committees.

Quality is born out of experience

There is no substitute for experience in achieving craftsmanship. You can depend on HumKo quality, because it, too, has been achieved by many years of experience devoted to the ideal of quality shortenings.

Since 1930, HumKo has specialized in the making of specialized shortenings for special uses.

Whatever your shortening needs, we invite your inquiries. Let our 25 years' history of manufacturing meat fat and vegetable shortening of the highest quality help you in meeting your shortening requirements.

RICHMIX Kopald PERFECTLY HYDROGENATED

SPECIAL RICHMIX SHORTENINGS

We feature special Richmix shortenings; emulsifier shortenings designed for particular uses. There's a Richmix label for you. Ask about it.

THE HUMKO CO.

MEMPHIS, TENNESSEE

Shortening specialists

NEW PRODUCTION TECHNIQUES WITH

Automation In Feed Milling

By Ward R. Flach*

SINCE FEED MILLING automation is such a new term in the feed industry, let's preface our discussion with a few — perhaps surprising — facts about the industry itself.

Feed milling is one of the nation's top ten industries, with more than 6000 plants located throughout the United States doing 4½ billion dollars of business a year. Thirty-five million tons of formula feeds were produced in 1954, and estimates have been made that by 1960 production will be around 55 million tons. It is a stable, not seasonal, business since feed is required on an everyday basis, and farmers are relying more and more on manufactured feeds.

A few years ago feeds were formulated by the hundredweight and contained eight to ten ingredients. Individual formulas now have as many as 30 different ingredients, and three-quarters of these may be formulated at less than 1%, many at a few grams per ton. No industry uses more complicated formulas, not even drug manufacturers. Your favorite cake has far fewer ingredients than are used in complex feed formulations.

Adequate nutrition, provided by protein, energy sources, vitamins, and minerals, is not enough. Formulations must also provide for disease prevention or for curative effects, through various drugs and antibiotics. For rapid growth, hormone-active chemicals are included at 10 parts per million.

Automation — No Innovation in Feed Handling

How does the industry make use of automation? Long before the coining of the word, the flour and feed milling industries were well advanced with their bulk storage, elevating legs, and belt and screw conveyors. More than 90% of the volume of ingredients used in feed formulations can be handled in bulk and moved into the mill by means of hopper railroad cars, power scoops, or the less laborious car dumper which, with its side- and end-tilting mechanism, can unload a boxcar in 5 minutes or less —a major step in efficient bulk feed handling. Not only grains, but many so-called soft feeds are handled in this manner: soybean meal, gluten feed, gluten meal, and distillers' and brewers' grains.

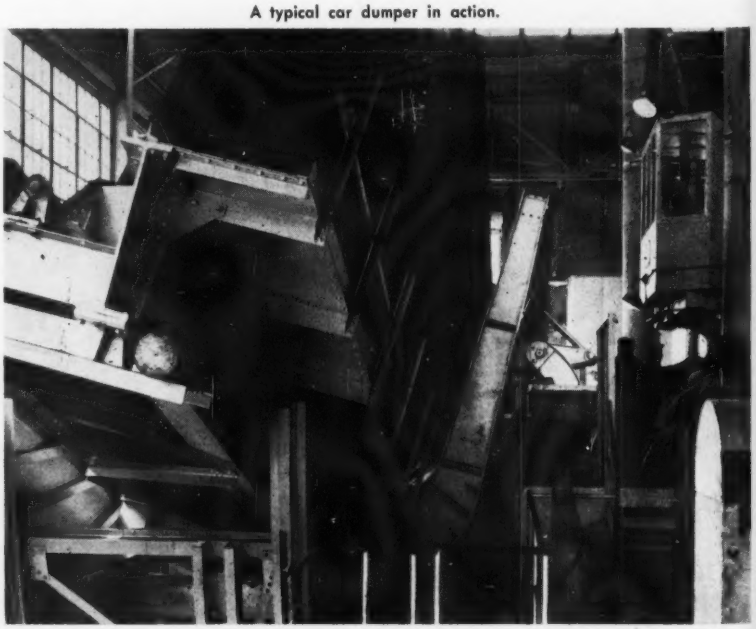
Let's consider how automation is applied to feed mixing, according to the three major methods: single batch, continuous batch, and continuous line.

In the single batch system, used in most small country mills, very little automation has been applied. Ingredients are handled entirely in bags and in packaged premixes of vitamins, drugs, and minerals, which are dumped into a batch mixer. The same crew loads the mixer and sacks the finished feed.

Automation in Continuous Batch Mixing

The continuous batch system has gained popularity recently in feed mills producing 25,000 to 50,000 tons annually, built on push-button principles and using remote control batching. Bins containing the various ingredients are located over a hopper scale and a single operator weighs out, by means of electronic valves, the proper amount of ingredient from

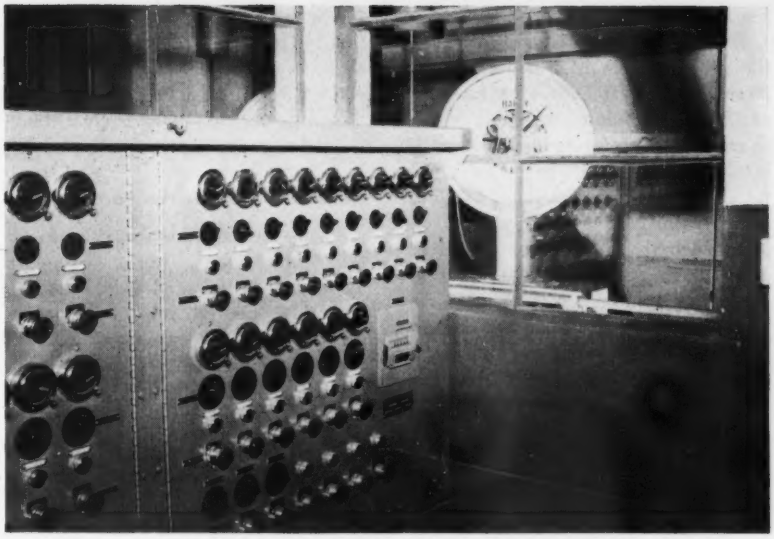
A typical car dumper in action.



* Laboratory Director, Eastern States Farmers' Exchange, Buffalo, N. Y.

each bin as indicated by a cumulative weight scale. These weighed batches, in the neighborhood of 2 tons, are then spouted alternately to each of two batch mixers. Thus, while one mixer is being loaded and in the mixing cycle, the other is discharging the feed into the packing unit. The alternating flow delivers a continuous supply of finished feed to the packing unit.

This method is very accurate; it is efficient in that it requires only one man for the whole operation; and it is versatile — the change from one formulation to another is made merely by changing the ingredient weight requirements. This versatility is of major importance in producing more than 30 different feed formulations and shipping them in mixed carloads containing many different types of rations.



Section of a "Push-button" control panel, with automatic scalers in the background.

Automation in Continuous Line Mixing

The continuous line system of mixing is adapted to large production units. Automation has played a major part, especially from the standpoint of accuracy, in line mixing systems. Volumetric feeders have been replaced to a great extent by gravimetric or weight-type feeders, set individually or from a remote-control panel. When the flow of feed is interrupted or is too little or too great, an alarm system not only signals the irregularity but shuts down the production line.

The feeders are synchronized with the collecting conveyor so that the ingredients flow on a timed weight basis and therefore are always in proportion no matter how small an amount is involved. After the ingredients have been collected from the feeders, continuous mixers incorporate liquids such as molasses and (in poultry feeds) animal fats. Rotometers have proved successful for automatic control of the flow of liquids to the mixer by means of a series of solenoid valves.

Major improvements have been made in packing scales. A weighing and checking system can be set up to reject any bag of finished feed of incorrect weight, before it moves out into the loading equipment of the warehouse.

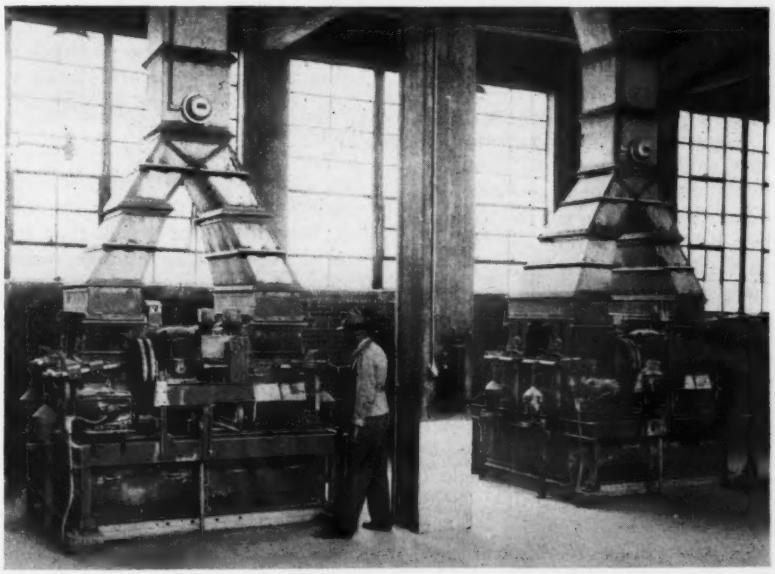
Finished feed from packaging units is generally carried by belt conveyor to loading positions, a method that has been in efficient use for many years, and there seems little opportunity for improvement here. Manpower is needed for receiving the bags from the belt conveyor and loading them into boxcars, trucks, or onto the warehouse floor — in most feed mills the only operation where feed is handled by men. Although many types of equipment have been tried, no satisfactory loader that is completely mechanical has yet been devised.

Automation in Sundry Operations

The feed market calls for two types of feed: first, a complete one with high energy for nongrain-producing areas such as the Northeast and the West Coast; and second, a blending of concentrates or supplements — principally soybean meal — to be mixed with home-grown grains for a balanced ration. The latter type has been widely accepted in areas of heavy grain production, especially the Midwest.

In the complete feed approximately 60% of the rations must be ground, for the most part by hammermills. Automation has been successful here. The flow of grain to the hammermill is controlled electronically by the power load on the grinding unit, so that the hammermill is always operat-

Scales above rotary packers.



ing at optimum capacity.

In conventional grinding systems the ground grain is drawn from the hammermill by means of a fan and carried to a cyclone, where it is discharged into an elevator leg and thence into the storage bin. The hammermill motor also powers the fan. Grinding capacity can be increased about one-third when air, from a source directly over the point at which the ground grain is discharged into the bin, is used to convey the feed away from the mill. The grain is thus lifted, by a slight suction of air, rather than being pushed from the hammermill by a fan attached directly to the grinding unit. This increased capacity is achieved with practically no added horsepower requirement.

Pneumatic handling has made great strides recently. Feed moved through tubes by large volumes of air at low pressure is actually fluidized, so that each particle is in suspension. Installation and maintenance costs are low; tubes are self-cleaning, for the feed can be moved horizontally as well as vertically.

Texture and Uniformity of Grind Are Important

Texture of grind must be regulated within a narrow range to avoid separation of the various ingredients in a finished feed and to ensure a minimum of both coarse and fine particles.

Uniformity of grind is also very important. When 100 pounds of feed are given to 750 chicks in their first and most important week of life, each chick gets about 2 ounces of feed, and even in such small amounts all nutrients, vitamins and other growth factors, and drugs must be uniformly distributed; if they are not, growth will be critically affected.

The importance of uniformity of mix can be seen in a formulation containing 4 grams of procaine penicillin, or 2 grams of cobalt sulfate per ton of feed. Low-level ingredients are first mixed with a suitable carrier, such as soybean meal or corn meal. This premix is checked for uniformity, with an analysis of any drugs it contains, and then is put into bins and used at a level of at least 10 pounds per ton. In a formula calling for ¼ pound per ton of a coccidiostatic drug, this ¼ pound would be mixed with 9¾ pounds of the meal, and the resulting 10 pounds would be incorporated in a ton of finished feed.

There is wide scope for automation in this aspect of feed milling, for we have no satisfactory equipment as yet for feeding small amounts, such as grams per ton, of electrostatic materials as individual ingredients.

Automation Helps the Farmer

From the farmer's angle, automation has made rapid progress. Though bulk finished feed has been available to him for many years, only in the past few years has there been any increase in on-the-farm use of bulk feeds; in fact, the major advance in automation of feeds has been in this area. The farmer finds in it a marked saving in labor, at a time when hired labor for the small-to-average farm is almost nonexistent. This situation contributes to a change of some economic importance that is taking place: small farm units are becoming less and less profitable for individual farmers and the average farm, especially in the Northeast, is growing in size and adopting such operational economies as the use of bulk feed.

From a near-by mill, bulk feed can be delivered by truck and blown into the farmer's bin through inexpensive piping 3 or 4 inches in diameter. These bulk "airveyor" units operate economically within a range of about 50 miles from a mill.

In the Northwest several large feed mills have set up centralized production units to handle volume and minimize inventories, especially of the more expensive minor ingredients, as against those needed in numerous small units. The mixed feed is shipped in bulk by hopper or boxcar to local units consisting of bins and scales: the bulk feed is transferred to these bins and then weighed out into trucks for farm delivery.

Another type of bulking program has been well received: Feed is shipped in sacks from a central milling location to warehousing points, and delivered in an ordinary truck equipped with an airveyor; thus if the farmer desires bulk, the bags can be emptied into the airveyor and elevated to his bulk bin by air or screw conveyor; if he doesn't require bulk, or wants small amounts of different types of feed, the sacks are readily available on the same load.

The Challenge of Automation

Automation has been defined as obtaining an objective, mostly mechanical, by means of self-contained automatic units. But no matter how well that objective is attained, we still must have men who understand the equipment and know the right button to push. Much would be gained, not only for the milling industry but for all others, if more work were done in human engineering — efforts aimed to get the right man in the right job. Authorities have discussed this subject at great length, but as yet no conclusive plan has come forth.

Rotary packers for hundred-pound bags of feed.

Realizing the importance of trained supervisory personnel, the feed industry through subscription has established the first school devoted entirely to feed technology, at Kansas State College. This program was started in 1955 on completion of the new feed milling building on the campus, and is run in conjunction with the long-established flour milling school there.

There is room for a great deal more of automation in feed milling. As spectacularly as the industry has advanced, animal breeding and animal nutrition have marched ahead even more rapidly. Many mills are being built to meet this challenge, but a larger percentage of mills are still mixing these complex rations without modern automation.

• • •

● At the check-out counter of a supermarket, a member of a research team asked a lady if she'd mind answering one question. She didn't mind.

"Why do you buy X brand of flour?"

"Well, white flour all seems pretty much the same today, but *this* brand clearly assures you that vitamins have been added. See, it tells you plainly on the package 'ENRICHED FLOUR' and lists the vitamins. We buy enriched bread and other foods with vitamins—so I say why not get that health advantage in the flour I use?"

The lady is absolutely right, and millions agree with her. That's why "ENRICHED" is a selling word.

But why "*Pfizer* enriched"?

For good reasons. To begin with, Pfizer has been a vitamin research and production center since the first vitamin was commercially produced. Bi-Cap® was one of the first enrichment concentrates. And this "head start" in vitamins has continued. What this means is that Pfizer can help you with the newest developments in enrichment products.

RIGHT NOW IMPROVED PFIZER BI-CAP is made with a new type of Riboflavin which gives it a *lighter color and overcomes unsightly agglomeration.* All three forms of BI-CAP are also made with Thiamine Mononitrate for better Vitamin B_1 stability.

Continued Pfizer research in riboflavin, thiamine and other health ingredients will help you offer your customers improved flour for tomorrow's improved bread and baked goods. Look to Pfizer for the finest enrichment concentrates.

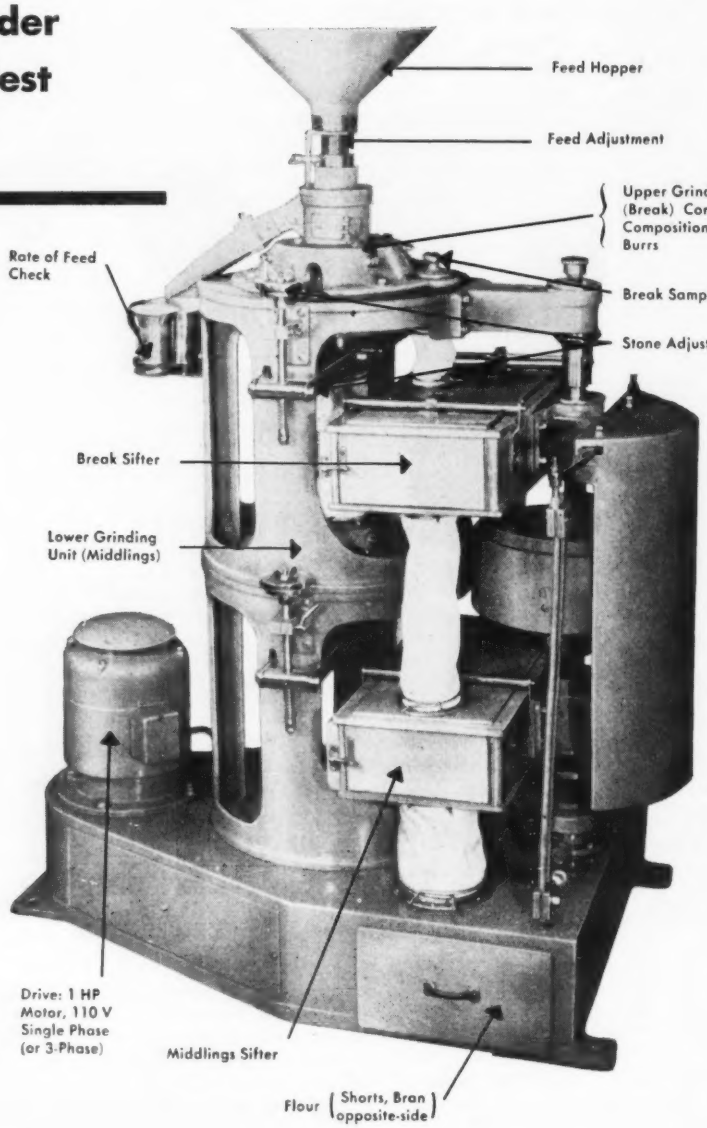
Pioneer and Leading Manufacturer of Vitamins

Pfizer

CHAS. PFIZER & CO., INC.
Chemical Sales Division
630 Flushing Ave., Brooklyn 6, N. Y.
Branch Offices: Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Texas

Be Ready for th

The Brabender Rapid Test Mill



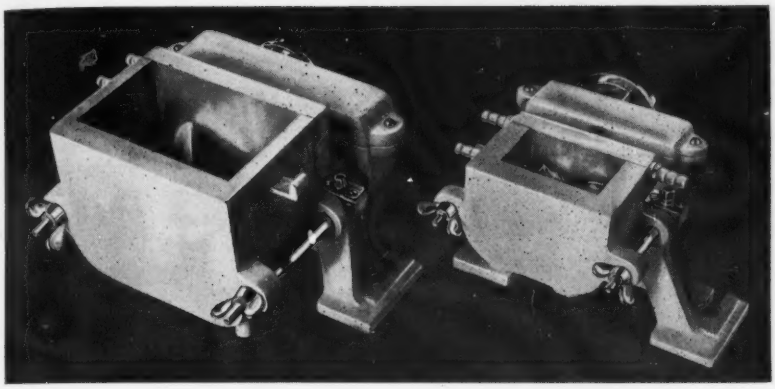
Ask for Booklet "What a Test Mill Should be Able To Do" and for *new* catalogue.

Brabender

C. W. BRABENDE

In England: **E. E. SIMMONS, "Tresco", Oakhill Avenue, Pinner, Middlesex**

NEW CROP



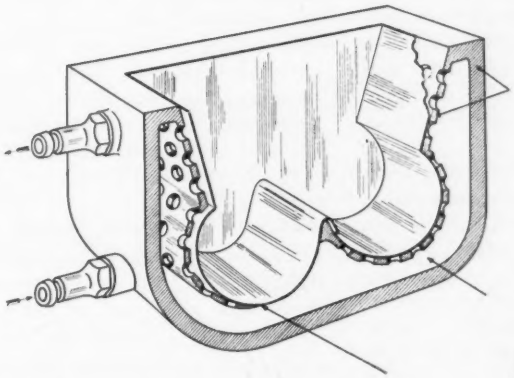
We can now offer the new Brabender-Hackensack Stainless Steel mixers, 1956 Series, in either the 300 g. or 50 g. sizes. We can calibrate these mixers with the same accuracy as the bronze mixers to either the world standard or other standard you may specify. These new stainless steel mixers can be relied on to duplicate the farinograph curves of the calibrated bronze mixers.

STAINLESS STEEL MIXERS

no longer a calibration problem!

Calibration of bronze farinograph mixers has always been a difficult and time consuming process, requiring high skill and experience. With the introduction of stainless steel mixers, these problems became difficult beyond all expectation. We have refused to accept orders for calibrated stainless steel mixers for many years until we were in position to solve this problem. Poor heat transfer between mixer walls and dough and the lower thermal conductivity of the stainless steel were found to be the main problems in these calibration difficulties. Depending upon the kind of stainless steel used, we found that the rate of heat transfer could be as much as ten times lower than that of bronze.

Without further explanation, the above phantom drawing shows how we overcame this problem.



Heavy bronze frame with high thermal conductivity.

Thermostat - circulated water is brought into close contact with the dough, being separated from it by only 0.3 mm. wall.

Stainless steel sheet, only 0.3 mm. thick. The lower thermal conductivity of the stainless steel is compensated for by the extreme thinness of the sheet.

INSTRUMENTS, INC. SOUTH HACKENSACK, NEW JERSEY Telephone Diamond 3-8425

Exclusively franchised Sales and Service Agents for the Milling Industry

MIAG NORTHAMERICA, INC.,

1616 South 8th St., Minneapolis 4, Minnesota
Telephone: FEderal 9-5713

AN AUTHORITY TELLS US WHAT'S WHAT ABOUT

Chemical Additives In Foods

By Paul E. Johnson*

OUR SOCIETY HAS become such that relatively few families produce a significant amount of the food consumed in their homes. Most of us live in urban, industrialized communities distantly removed from the sites of food production. To provide an abundant, wholesome, and economical food supply for a society of this kind, large amounts of foodstuffs must be produced efficiently by a relatively small segment of the society. The processing, preservation, and storage of these foodstuffs must be accomplished with minimum waste and loss of nutritive value; and further, they must reach the consumer in a sanitary condition. The consumer expects, moreover, that the foods will be diversified, pleasant to the senses, and convenient to use.

Many technological developments are applied in the production, processing, preserving, and storing of this food supply. Important among them is the use of chemicals. This use results in the occurrence in foods of materials other than the basic foodstuffs. These substances have been termed "chemical additives."

Chemicals are added to foods by the processor for the purpose of imparting a desired quality to the product or for serving a functional purpose in it. Such substances have come to be known as "intentional chemical additives."

Other chemical substances which serve no useful function in the finished product occur in foods as a consequence of their having been used in the production, processing, or storage of the food. These are sometimes called "incidental chemical additives."

Intentional Chemical Additives

The food processor uses a large array of chemicals to perform specific technological functions in his products. They are used in different variety and amount in all of the major processed foods. A recent compilation lists over 500 such intentional chemical additives.[1] They facilitate processing and formulation, inhibit deterioration, enhance and maintain nutritive value, and improve the appeal and acceptability of foods.

Additives for Texture Appeal

Additives in wide variety influence or stabilize the texture of processed foods. They are important both in the processing and formulation of the food and in producing an esthetically pleasing product. Complex phosphates and other poorly ionized salts, the so-called emulsifier salts, stabilize processed cheese and maintain water content of some processed meats. Surface-active agents (emulsifiers) aid immensely in the preparation of stable and homogeneous mixtures containing fats. In many processed foods they help maintain pleasing texture and prevent separation of fat from other components.

A third group of additives used to influence texture includes a number of natural and synthetic gums, pectin, agar-agar, and Irish moss derivatives. These thicken food preparations and aid in stabilizing mixtures of ingredients. Other chemicals are employed as firming agents for canned fruits and vegetables and pickles, as humectants to maintain desirable moisture content of many foods, or as anticaking agents in finely powdered preparations. Still others influence texture by virtue of their leavening power.

Additives for Preservation

Familiar preservatives in processed foods are those which prevent development of rope in bread and mold in bread, cheese, and other foods — usually sodium diacetate and sodium or calcium propionate. Other well-known preservatives are benzoic acid and sodium benzoate. These and some other chemicals prevent deterioration of food resulting from growth of microorganisms. Another kind of deterioration, resulting in loss of palatability and, frequently, of nutritive value, is due to oxidation of some component of the food. To inhibit this kind of deterioration, a number of antioxidant chemical additives are employed. Among them are the sulfites and bisulfites and a group of organic compounds. Ascorbic acid (vitamin C) is one of these. Derivatives of hydroxytoluene, hydroquinone, and guaiaretic acid are also widely used.

Enhancement of Nutritive Values

Readers of *Cereal Science Today* are, of course, familiar with the use of additives to enhance the nutritive value of processed foods. Vitamins and essential minerals are added to many foods for this purpose, most importantly to flour, bread, and milk.

* Executive Secretary, Food Protection Committee, Food and Nutrition Board, National Research Council, Washington, D. C.

[1] Food Protection Committee. The use of chemical additives in food processing. Publication No. 398, National Academy of Sciences, National Research Council, Washington, D. C., February, 1956.

Additives for Esthetic Appeal

Esthetic appeal of foods is influenced in many ways by chemical additives. Two groups of additives are used entirely or primarily for this purpose, however: the flavoring agents, which include a large number of synthetic aromatic chemicals, essential oils, extracts, and condiments; and the food colors. A number of naturally occurring dyes and the sixteen synthetic colors certifiable for food use by the Food and Drug Administration may be used. In addition to added colors, other chemicals are employed to influence the color of processed foods. Familiar examples of this usage are the bleaching with various oxidizing chemicals of flour and of milk for the manufacture of certain types of cheese, and the development and fixing of color in cured meats through the reaction of nitrates with natural pigment in the meat.

Improvement through Acidity

It is frequently desirable to increase, decrease, or stabilize the acidity of a prepared food. Adjustment of acidity may be necessary for satisfactory processing or formulation of a food, as in buttermaking or cheesemaking and in baking. It may be a means of enhancing palatability as in fruit juices, ice cream and sherbets, and soft drinks. Or it may aid in preservation, as in pickles and relishes. The chemicals used for these purposes are organic acids (such as occur in common fruits, vegetables, and other foods) and their salts, and a few inorganic alkalis, acids, and salts.

These examples of the technological reasons for using intentional chemical additives in processed foods indicate the important role these materials play in making possible the diversified, economical, and abundant food supply we enjoy.

Incidental Chemical Additives

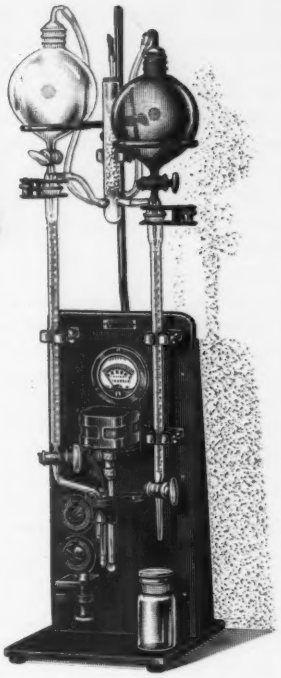
A large number of chemical compounds which serve very important functions at various stages in the production, processing, and storage of foods are not intended to be present and serve no purpose in the finished food. Small amounts of many of them do, nevertheless, appear in our foods.

Growing crops are protected by chemical pesticides from attack by in-

You get the best for less

NEW! Waco Titrator

...for Karl Fischer MOISTURES



At $210.70 complete, the new WACO for Karl Fischer moisture determinations now feature NO-DRIP BALL JOINT Pyrex glassware . . . plus Drain Flask, WACO magnetic stirrer . . . for every application! Hundreds of users of the original WACO may also modernize as parts are INTERCHANGEABLE.

(No. CS-5653A) The new WACO Reservoir is now supplied with Ball Joint! Capillary outlet and silk finish grinding provide positive NO-DRIP feature! Reservoir also has Amberized finish to avoid deterioration of Fischer Reagent.

Reprinted from ANALYTICAL CHEMISTRY
Vol. 27, Page 450, March 1955

Copyright 1955 by the American Chemical Society
and reprinted by permission of the copyright owner

IMPROVEMENT IN KARL FISCHER METHOD FOR DETERMINATION OF WATER

A substantial gain in stability can be achieved by substituting methyl Cellosolve for methanol in the formula for Karl Fischer reagent. In addition to its greater stability, the modified reagent extends the applicability of the method by permitting an appropriate choice of sample solvent. Methanol is an undesirable solvent in some cases because of interfering side reactions with the sample. A mixture of ethylene glycol and pyridine permits the direct titration of water in ketones and some aldehydes and improves the direct titration of water with Fischer reagent to the reverse dead-stop end point.

NEW USES . . .

Side reactions which previously interferred are definitely reduced by this new reagent. You can use the rapid Fischer method of moisture determination on many additional products where it was previously unsuccessful.

GREATER STABILITY, LOWER PRICE

It lasts for a year! This means you can buy it by the gallon at a cost lower than mixing your own. Saves the need for frequent standardization during the day too.

Why Pay $595 — Waco Titrator Costs Only $210

Write for New WACO Titrator bulletin CS-7 and new Directions, based on the latest technics!

LABORATORY SUPPLIES AND CHEMICALS
WILKENS-ANDERSON CO.
4525 W. DIVISION ST., CHICAGO 51, ILLINOIS

sects, slugs, nematodes, and other animals, and disease-causing viruses, bacteria, and fungi. Pesticides are used to protect cattle and other stock from parasites. Insecticides and rodenticides may be used to prevent damage to stored foods. Small residues of these materials often remain on the food, even after thorough cleaning and several processing procedures.

Packaged food is, of course, in close contact with the container, and by abrasion or solution and extraction, material moves from the package into the food. The number of chemicals added to our food in this way is unknown, but the total amount of them is small.

Public Health Considerations

The foregoing discussion has shown that more than 500 chemicals may be purposely added to foods, and that an unknown number of others may occur incidentally in them. The fact that this seemingly large number of chemical additives enters the food supply has caused concern among some thoughtful persons and called forth alarming predictions from others about the hazard to public health that may arise from the use of chemicals in food production, processing, preservation, and storage.

The most serious concern has understandably been over the use of the pesticides. Most pesticides are, obviously, poisonous in some degree to some form of life. Many of them are acutely toxic to many species. It is reasonable to assume that they may be toxic to man also. But toxicity and hazard are not synonymous. Toxicity is the capacity of a substance to produce injury; hazard is the probability that injury will result from use of the substance in a proposed quantity and manner.

There appears to be almost no hazard of acute poisoning from using food that has been commercially produced with the aid of the pesticides now marketed. No death or incidence of poisoning has authentically been traced to such use. This is an outcome to be expected. The minimum lethal dosages of the pesticides for experimental animals are known fairly accurately, and it would be only by accident that any such dosage would appear in a food as a result of crop production operations.

It is impossible to be so positive in speaking of the hazard of chronic effects arising from use of food crops treated with pesticides. It is true that no death, illness, or increased incidence of any disease has been authentically associated with such use. But it is extremely difficult to prove that there is no association, because of the nature of some chronic toxic effects. The effect may be so far removed in time from the cause as seemingly to have no connection with it. Or the development of the toxic effect may be so gradual as to seem unassociated with anything specific in the environment. Since it is impossible to demonstrate the complete absence of hazard of this kind, a decision to use a pesticide on food crops must be based on the practical certainty that injury to the consumer will not result.

These considerations of hazard are recognized by the laws and regulations governing the use of pesticides on food crops. The maximum pesticide residues permissible on raw agricultural commodities in interstate commerce are established by the Food and Drug Administration. The amount permitted is based on a knowledge of the chronic toxicity of the pesticide in laboratory animals. This is determined by tests in which the pesticide is fed to groups of animals at various dietary levels for the lifetime of the animal or for a year or more. *The amount permitted is far less than the smallest amount that caused any injury in the experimental animals.*

Legislation for Safe Foods

The same principles of hazard and safety apply to the use of intentional chemical additives and incidental additives other than pesticides. But since the chemicals used for these purposes are in general inherently much less toxic than the pesticides, hazard from their use has perhaps not appeared to the public as imminent as the hazard from pesticides. There is concern, however, over possible dangers to public health from the increasing number of these chemicals used or proposed for use in foods. This concern is reflected in the number of bills before Congress proposing to amend the Federal Food, Drug, and Cosmetic Act to ensure that the proposed chemicals are safe. About a dozen such bills were submitted for consideration by the present Congress. None has been passed, but it seems certain that efforts to amend the law will continue, since the various segments of industry concerned with the manufacture and use of chemicals in food processing, legislators, and public health officials all advocate the changes. Most of the proposed amendments would require that the safety of a chemical for a proposed use be established by the sponsoring industrial concern before the use is permitted. The present law prohibits the inclusion of harmful or deleterious substances in foods — unless the occurrence cannot be avoided or unless the use of the substance is necessary; in such cases, tolerances may be prescribed. But proof that a harmful or deleterious substance is present is the responsibility of the enforcement agency.

The Manufacturer Tests for Safety

Actually, in present practice, the manufacturer of a chemical newly proposed for use in foods usually conducts tests necessary to establish safety. The tests may or may not be sufficient, according to modern toxicologic thinking, to permit the judgment that it is practically certain that no injury to the consumer will result from the proposed use. If they are not, the manufacturer will be so advised by the control agency concerned. On the basis of completed tests, the control agency will indicate informally to the sponsor whether or not it considers the additive to be safe. The proposed amendments would in effect, therefore, formalize what is now being done informally. They would in addition provide machinery for resolving differences of opinion based on interpretation of available information.

The awareness of public health officials, legislators, and the industries involved that health problems associated with the increasing use of chemical additives in foods may arise, and their effects to maintain the safety of the food supply, should be reassuring to the consumer. But there is no room for complacency. The consumer must continually be vigilant that no additive be permitted to be used in food unless it is of benefit to him and unless it is safe to use as proposed. Benefit to the consumer may be a matter of opinion and difficult to define, but might involve economics, esthetics, and convenience. Questions of safety, however, can be answered on the basis of competent scientific evidence alone.

ARMED FORCES RESEARCH LEADS TO NEW AND BETTER

Packaging of Cereal Products

By Albert V. Grundy*

PROGRESS IN THE packaging of cereal products in recent years has has been evident more in attractive exteriors than in protective and other necessary functional properties.

This emphasis on appearance is a natural outgrowth of the sales appeal motif. Device after device has been used on cereal packages to catch the eye of the buyer — or the buyer's children. Thrilling portrayals of "Superman," of outstanding athletes in all forms of sport, of pioneer heroes Davy Crockett and Daniel Boone, are displayed on supermarket shelves with irresistible appeal to Young America. The colorful and stimulating exterior serves as a come-on for an inner appeal of puzzles, miniature plastic figures, and other interest-provoking gadgets for young folk — all, of course, aimed toward stimulating sales.

Let me hasten to say that no criticism is intended. This preoccupation with appearance is the natural evolution of modern merchandising, and progress never ends in food merchandising.

Functional protection, however, though inconspicuous, is a matter of paramount importance. We now have rich resources in materials for achieving it, and more emphasis is being placed on this aspect of packaging. Alone or in combination with others, these materials can be used on high-speed filling and closing equipment, making desirable internal or external protective barriers. Only those innovations that have been put into use since World War II will be discussed. Most of them are laminants for exterior or interior barrier protection, and most of the base materials are familiar to all.

Innovations in Commercial Packaging Materials

These new materials, applied to packaging of cereal and other food products, have definitely improved contents protection. They have increased moisture repellency, eliminated absorption of off-odors, and at the same time have permitted great improvement in eye appeal because of their better acceptance of printing and color.

The illustrations show both the high-quality multicolored printed cartons and bags or external protective wraps and the inner protective barrier bags, made of foil-tissue-wax combination, and of foil paper. The latter, which is a combination of polyethylene, foil, and plasticized paper, is essential for cereal items that must be completely protected from external moisture.

Plastic films are successful as protective covering for a wide variety of foods, ranging from potatoes and bananas to beefsteaks. Some of these

A variety of "gimmicks" used on packages to stimulate sales appeal to Young America.

* Director, Container Laboratories, Quartermaster Food and Container Institute for the Armed Forces, Chicago, Ill.

Various types of packaging, some with inner protective barriers.

uses have come about through improvements in packaging machinery. Polyethylene is a good example. From 1944 to 1946 the principal means of sealing polyethylene was by flame-sealing or hot wire. Now, with specialized equipment such as rotary band and thermal impulse sealers and modifications of high-speed filling and sealing equipment, polyethylene has become as much a work-horse in the packaging field as cellophane and waxed paper, replacing older types of heat-seal coatings. Blended with paraffin waxes, polyethylene imparts improved characteristics to waxed paper, waxed board, and the like.

New Kinds of Packaging Machinery

High-frequency electronic sealing and other machine developments have accelerated the use of Saran for self-service sausages and meats. Vacuum-forming methods and equipment will bring out some new and novel methods, such as the packaging of fresh shelled eggs in cups of vacuum-drawn polyethylene closed with a heat-sealed polyethylene cover. Polyethylene-coated foil is laminated to pouch paper for dehydrated soups and other dry foods in place of old stand-by packages. These innovations can be seen at first hand in any supermarket.

Quite recently, other protective qualities have been added. In impregnated packaging, mainly for cheese and other dairy products now, but also in some cereal packages, sorbic acid is used to increase mold resistance. Still more recently, additives to be impregnated into packaging material have been suggested as protection against oxidation of fats and oils.

Thus far, we have been reviewing innovations in commercial packaging. The military forces have had an even keener interest, for obvious reasons, in package development and in spearheading new thinking in this field; some of the actual realities in use for military food packaging are shown in the accompanying table.

Forecast: Materials

What about the future? Current trends in materials can be projected

Developments in Military Packaging Since World War II

COMMODITY	DEVELOPMENT
Instant coffee Instant tea Dehydrated soup Cocoa beverage powder	Acetate foil package has been replaced with one consisting of polyethylene, extruded on aluminum foil, laminated to pouch paper. Result: increased protection at lower cost.
Frozen poultry, fish, meat	Polyethylene, Saran, Pliofilm, etc.
Canned foods	Tin content of cans has been reduced for approximately 90% of these items. Reductions range from 25% to 300%.
Dry cream, coffee type	Developed after World War II, sparked development of nitrogen gas packaging in small envelopes. Pliofilm is laminated to foil backed with acetate. Residual oxygen level in package less than 2.5%.
Compressed flour	Studies are being made to determine feasibility of compressing flour in 5-gal. cans. Compression will save 20% in cubic space — important where storage space is limited, i.e., aboard submarines.
Dehydrated meals	Flexible and semi-rigid prototype containers for dehydrated meals: package to serve as reconstitution vessel, heating or cooking vessel, and serving utensil.
Veal loaf Turkey loaf	Recently developed carton for frozen loaf-type meat items serves as container and also as baking pan in mess hall; made of foil laminated to bending board, foil forming the inner surface. In mess hall, the cook merely cuts vents in top and pops the carton into oven.
Grains and cereal products	To combat insect infestation, outside ply of multiwall paper shipping sacks, used for Armed Forces flour, is treated with 5 mg. of pyrethrins and 50 mg. of piperonyl butoxide per sq. ft. This treatment probably will be used for grain and cereal products other than flour.

to give us clues for further developments. For example, there is Mylar (polyethylene terepthalate), and a polyethylene-Mylar combination to eliminate difficulties encountered in the sealing of Mylar. There is also Mylar film metalized with aluminum, with heat-extruded polyethylene on the metalized side of the Mylar film. The aluminum used as metalizer, only a few molecules thick, effectively plugs up the pores of the Mylar film, thus appreciably reducing its rate of moisture vapor transmission (M.V.T.). A film of 0.0005-inch Mylar coated with 0.002-inch polyethylene has an M.V.T. rate of 0.071 g. per 100 square inches per 24 hours at 73°F. and 50% R.H., whereas aluminum-metalized Mylar-polyethylene of the same gage has an M.V.T. rate of approximately 0.004 g. per 100 square inches per 24 hours at the same temperature and humidity.

In hydrocarbon plastics there are low-pressure polymerized polyethylene, polypropylene, and polymethylstyrene. All of these newer plastics have one characteristic in common: resistance to temperatures of 250°F. or higher. Such materials will open the door to pasteurization or sterilization of foods and pharmaceuticals in plastic packages and the use of plastic containers as cooking and serving utensils. There has been a decided commercial trend in this direction; for example, the use of Saran and Pliofilm as casing for heat-processed sausage. More recently frozen poultry has been packaged in foil containers that protect during storage and also serve as the cooking utensil. Newest is a poly-Mylar combination for frozen foods, the food being thawed and heated in the plastic bag.

The unique properties of these new materials will be used to advantage: Mylar film's tensile strength where strength is important, and fluorocarbon film's chemical inertness for packaging corrosive materials.

Forecast: Packaging Machinery

Little has been said here regarding packaging machinery. This is a whole field of study in itself, but there is no doubt that cereal packaging is moving toward automation. Machines are already available which form, fill, seal, and wrap cereal packages at very high speeds. The automatic wrapper, which will handle more than 100 different items of all sizes, is being used for labeling, wrapping, and sealing rolls, pies, coffee cakes, and other specialty bakery items. Adjustment for size is made simply by turning a single hand wheel. Irrespective of odd size or shape, this machine will wrap up to 40 items per minute. Wrapping may be controlled so as to be either tight or loose, with either end or bottom fold.

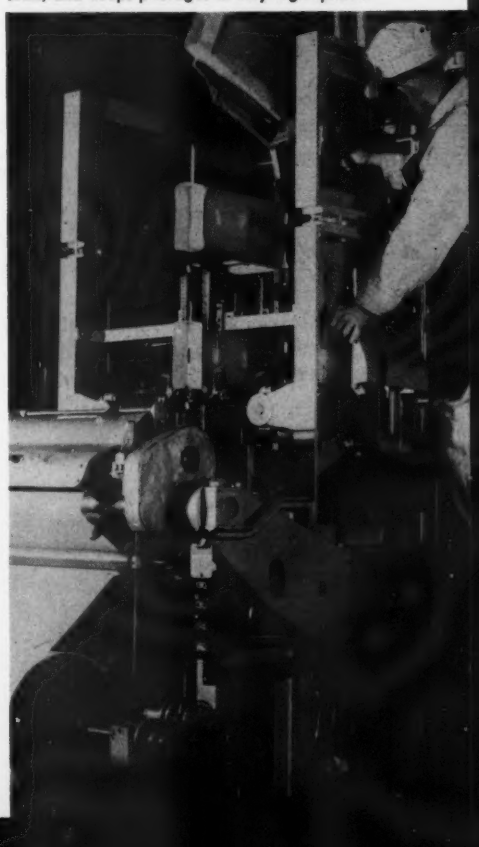
The prime purposes of packaging are to deliver the goods to the consumer in usable condition and to aid in selling the product. All of this must be achieved at the lowest possible cost. Current packaging is governed by marketing practices; future developments will either influence or be influenced by new materials, new methods of high-speed operations, and changing methods of marketing and merchandising, which are all closely interrelated.

●

Products pictured in this article are used to illustrate packaging principles only; no endorsement of these products over others in the same category is intended.

Grateful acknowledgment is made to my colleagues of the Quartermaster Food and Container Institute for the Armed Forces for assistance in obtaining certain data and illustrations used in this article.—A.V.G.

A packaging machine of this type forms, fills, seals, and wraps packages at very high speeds.



BOOK reviews

Papierchromatographie in der Botanik, edited by H. F. Linskens, 253 pp. Springer-Verlag, Berlin, Gottingen, Heidelberg, 1955. Reviewed by A. J. LINCK and J. E. DeVAY, University of Minnesota.

This book is a reference source and laboratory manual on paper chromatographic techniques, including applications of paper electrophoresis useful in studies of plant materials. It is divided into two parts, the first on general information and the second on specific methods.

In the first part, H. F. Linskens discusses the basic requirements of a paper chromatography laboratory and covers in detail, with excellent illustrations, various techniques involving paper partition chromatography and paper electrophoresis. The characteristics and uses of different filter papers for chromatographic separations, the influence of contaminating substances in plant extracts on chromatogram development, and the use of different sprays are briefly reviewed. Linskens also discusses methods of interpreting and presenting results of chromatographic analyses.

The first part of the book is concluded with a discussion by B. D. Sanwal on qualitative and quantitative chromatographic procedures involving radioisotopes.

In the second part of the book, sections on the paper chromatography of inorganic ions, their identification and quantitative estimation, by H. Seiler and B. Prijs, as well as the separation and determination of carbohydrates and sugar derivatives using partition chromatography and paper electrophoresis, by L. Stange, are well written and adequately summarize recent literature.

In a section on growth substances S. P. Sen has brought together much of the current literature on the separation of indole derivatives and growth-regulating aromatic acids. This chapter includes methods for the separation of many substances and should serve as a valuable reference source. Several procedures for the quantitative estimation of these compounds are also discussed.

Methods for the separation and quantitative determination of various organic acids are given in an up-to-date review by H. Schweppe, while C. A. Wachtmeister has summarized the current literature on the paper chromatography of fumaric acid. A brief but pertinent discussion on the preparation of amino-acid and peptide extracts and their qualitative and quantitative analysis using various chromatographic techniques is presented by H. Dörfel.

The editor of this volume, H. F. Linskens, has contributed sections on paper chromatography of enzymes, nucleic acids and their derivatives, as well as on vitamins and phenols which are useful reference sources. He has also presented a section on the separation of bound cellular pigments which is followed by a review on the paper chromatography of free or sap-soluble pigments by R. Hänsel.

Methods for the separation and quantitative estimation of antibiotics using paper chromatography have been reviewed by S. Yamatodani, while H. Zähner has presented a short section on several microbial toxins.

The final section by A. Romeike on the separation of plant alkaloids should be of considerable use in studies on the purification and identification of such substances.

This book is a useful addition or supplement to several other excellent contemporary reference books and laboratory manuals, written in English, on chromatographic techniques. However, the omission of a section on the theory of paper chromatography limits the value of this book with regard to students and research workers who are unfamiliar with chromatographic methods.

Advances in Agronomy, Volume VII, edited by A. G. Norman under auspices of the American Society of Agronomy. Academic Press Inc., New York, 1955. 431 pages. Price $8.80. Reviewed by GEORGE R. BLAKE, University of Minnesota.

This volume contains ten reviews of subjects important to soil and crop science. Though they are not intended to be related, four chapters stemmed from a 1954 soil microbiology conference: "Soil aggregation," "Mineral nutrition of plants as related to microbial activities in soils," "The enigma of soil nitrogen balance sheets," and "The place of microbiology in soil science." Two other chapters deal with closely related subjects: "Green manuring viewed by a pedologist," and "Mineralization of organic matter."

Four chapters consider subjects of primary importance to crop scientists: "Recent changes in Swedish crop production," "Improvement of the sugar beet in the United States," "Plant introduction as a Federal service to agriculture," and "Weed control in principal crops of the Southern United States."

The subjects are individually specific and thorough; collectively they treat varied topics and will thus interest a wide audience.

Readers will find the articles thought-provoking, though perhaps they will disagree with some of the assumptions made and conclusions drawn. Even this may be desirable where evidence on some important phase of the subject is inconclusive or apparently contradictory.

THE USE OF CHLORTETRACYCLINE-AUREOMYCIN IN POULTRY PRODUCTION[1,2]

ROBERT WHITE-STEVENS, H. G. ZEIBEL, and N. E. WALKER, Nutrition and Physiology Section, Research Division, American Cyanamid Company, Pearl River, New York

THE BUSINESS OF poultry production can be classified into four distinct areas of research and practice:

1. Genetics — the development, production, and maintenance of good breeding stock to supply chicks of high quality to commercial farms.

2. Nutrition — the discovery and identification of essential nutrients, their economic production, and their addition to the diet for a specific purpose, such as producing meat, eggs, or chicks.

3. Pathology — classification of disease symptoms; isolation of causative pathogens and their therapeutic and prophylactic control.

4. Management — integration of the above factors into practical and economical application, under commercial field conditions.

These four areas must, under practical farm conditions, be practiced in a system of strict interrelation at all times. At least until recently, however, investigation has treated them as essentially discrete entities and research has remained largely independent rather than interdependent.

Perhaps the first really significant breakdown in the separation of these four areas of poultry production occurred in 1948 and 1949, with the discovery of antibiotic effect on growth.

Any concept of nutrition as separate from disease must include an interpretation of nutrition in relation to disease and vice-versa. There can be no finite division between the two areas of research, except under an extremely refined and essentially impractical environment.

Early work on continuous feeding of antibiotics to poultry was concerned only with "low" levels (1 to 10 parts per million of diet). The greatest response appeared when the antibiotic was started as early in the life of the host as possible (18, 19, 25, 26, 29). Often the margin of gain secured from the low level of the antibiotic disappeared later in growth, even though the low level was continued in the diet (14). Furthermore, when the antibiotic at low level was introduced after 8 to 12 weeks, the effect on growth was small or insignificant. Two factors need consideration in the interpretation of these findings:

(a) Feed intake per unit of body weight declines rapidly in chicks from hatch to 12 weeks and continues to decline at a lower rate to full maturity at 18 to 20 weeks; and therefore, a drug fed at a constant level in the diet necessarily declines coincidentally with age and size in terms of drug intake level per unit of body weight per unit of time. Thus, the activity of the drug could be expected to decline in efficacy with enhanced body weight of the host.[3]

(b) The quality and quantity of deleterious microflora can be expected to increase rather than decline in an environment continuously occupied by birds at close quarters.

These two points clearly suggest that, if under practical conditions low-level feeding of antibiotics becomes ineffective with increasing age of the host, the cause is most probably too little antibiotic combined with too much contamination.

TABLE I

FEED INTAKE OF CHICKS AND RELATED ANTIBIOTIC INTAKE AT VARIOUS LEVELS IN THE DIET (EXPERIMENT 977-52-5)

(Feed, g/g body weight per day; drug, mg/kg body weight per day)

AGE PERIOD	AUREOMYCIN LEVEL IN DIET, G/TON					
	10		100		200	
	FEED	DRUG	FEED	DRUG	FEED	DRUG
Weeks	*g.*	*mg.*	*g.*	*mg.*	*g.*	*mg.*
0–2	0.21	2.3	0.19	21	0.20	44
2–4	0.13	1.4	0.12	13	0.13	29
4–6	0.15	1.7	0.13	14	0.13	29
6–8	0.11	1.2	0.09	10	0.09	20
8–10	0.09	1.0	0.07	8	0.08	18
10–12	0.07	0.8	0.07	8	0.06	13
Av.	0.13	1.4	0.11	12	0.11	26

Data in Table I show that feed intake per unit of body weight declines rapidly in growing chicks and with it the possible maximum intake of antibiotic. Drug intake at the low feeding level (10 g. per ton) declines rapidly after 6 weeks of age and could easily fall below the minimum effective level, whatever it might be in any given environment.

TABLE II

BLOOD SERUM LEVELS OF AUREOMYCIN IN RELATION TO DRUG LEVEL IN DIET AND AGE (EXPERIMENT 977-54-70)

AGE DAYS ON DRUG	CHLORTETRACYCLINE IN DIET, G/TON		
	10	50	100
	γ/ml [a]	γ/ml	γ/ml
1	0.025	0.145	0.355
7	0.050	0.085	0.190
14	Negative	0.055	0.095
11 weeks [b]	Negative	0.015 to 0.050	0.020 to 0.060

[a] Test sensitive to 0.005 per ml.
[b] Data after Broquist & Kohler (8).

Table II indicates that at a low level of aureomycin in the diet (10 p.p.m.) a detectable blood level can be

[1] Manuscript received October 27, 1955.
[2] Aureomycin is the trade name of the American Cyanamid Company for the antibiotic chlortetracycline.

[3] White-Stevens, R. H. Paper before Informal Poultry Conference, Federation meetings, Atlantic City, N. J., April 1954.

found up to 7 days of age, while appreciable serum levels of the drug are found in chicks fed 50 and 100 g. of Aureomycin per ton at least to 11 weeks of age.

Thus, it may be that if systemic effects of the antibiotic are important, and if 10 p.p.m. of the antibiotic in the diet fail to influence growth effectively after 4 to 6 weeks of age, then higher levels of drug per unit diet should be applied.

Results with both humans and animals have shown that Aureomycin, at 5 to 20 mg. per kilo of body weight per diem over the course of treatment, is effective against a wide spectrum of microorganisms (1). Aureomycin at 50 to 200 g. per ton will provide such daily intakes in poultry. The precise level to be employed under practical conditions is related to the size of bird, the epidemiology and the endemic diseases in the particular environment, and the economics of the situation. It would seem that use of the drug should not be confined to restricted periods of therapy, as the evidence is that disease depresses the efficiency of feed utilization before a diagnosable syndrome appears. In cases of chronic infection such an incubation period may be quite prolonged, as for example in chronic respiratory disease (C.R.D.) of chickens and turkeys (40, 41).

The experimental findings discussed below were used to determine how under practical farm conditions the feeding of Aureomycin at dietary levels of 50 to 200 g. per ton would affect growth efficiency in the presence of various endemic diseases.

Experimental Studies of Aureomycin at High Level in Poultry Diets

All experiments were conducted in areas of known endemic diseases, particularly C.R.D., the air-sac disease complex, and the nonspecific enteritis disease complex (blue comb). In addition, acute endemic diseases in the areas studied include Newcastle disease, coccidiosis, infectious bronchitis, synovitis, coryza and seasonal laryngotracheitis, and fowl pox. In all cases appropriate prophylactic measures were used to control these acute diseases.

Many of the trials were on experimental farms where straight-run birds, 200 to 400 per pen, were treated differentially and with suitable replication in a valid statistical design. Such trials have been run in New York, New Jersey, Delaware, Maryland, and Georgia. Other experiments were carried out in collaboration with university and state experiment stations, and were also suitably replicated in discrete pen units. Still other trials were made with commercial growers, hatchery operators, and feed manufacturers and their dealers; these were more in the nature of demonstrations than completely controlled experiments so that replication was not always feasible, although treatment units were usually of large populations, i.e., 1000 to 5000 birds. Observations made on all trials were essentially of the same type, except that the multireplicate small-unit trials provided greater experimental detail.

Well-balanced and adequately fortified basal diets were used in order to eliminate any possible enhancing effects of dietary deficiencies on the response to antibiotics (11, 24). Diets employed for broilers, turkeys, and laying birds are given in Table III.

TABLE III
BASAL DIETS EMPLOYED FOR EXPERIMENTS WITH BROILERS, TURKEYS, AND LAYING HENS

INGREDIENT	BROILERS	TURKEYS	LAYERS
	lb/ton	*lb/ton*	*lb/ton*
Fish meal (60%)	100.0	120.0	106.0
Meat scrap (50%)	100.0	80.0	80.0
Soybean meal (44%)	400.0	800.0	212.0
Corn dist. sol.(28%)	50.0	...	...
Yellow corn meal	1200.00	700.0	1240.0
Dehydrated alfalfa meal (17%)	40.0	40.0	106.0
Corn gluten meal (42%)	...	100.0	...
Wheat midds (18%)	...	...	106.0
Pulverized oats (12%)	...	...	106.0
Bone meal	...	50.0	...
Dicalcium phosphate	20.00	...	52.0
Limestone	...	30.0	...
Fortafeed 2-49C	1.0	2.0	3.0
Choline 25%	5.0	12.0	5.0
Vitamin A and D concentrate[a]	2.0	5.0	3.0
Iodized salt	5.0	5.0	5.0
Vitamin B_{12} concentrate[b]	1.0	0.25	0.25
Vitamin E supplement	...	1.0	...
Folic acid supplement[c]	0.1	...	0.1
Manganese sulfate	0.35	0.5	0.5
Exp. variables + soybean meal carrier	54.0	56.0	40.0

[a] 10,000 units vitamin A, 2,000 units of vitamin D_3 per lb.
[b] 10 mg. vitamin B_{12} per lb.
[c] Contains 3% folic acid.

The following observations were made for each pen of birds:

(a) Weight per bird at hatching and at 2-week intervals to 12 weeks of age.

(b) Feed consumed weekly.

(c) Daily mortality. A course of mortality involving more than 0.5% per pen on two consecutive days was regarded as an outbreak of disease, and suitable specimens were immediately referred to the nearest college, state, or industrial poultry pathology laboratory for diagnosis. Such diagnoses were always obtained where introduction of a known disease was included in the experimental plans.

(d) Notes on general performance, feathering, litter conditions, etc. were recorded weekly.

(e) In certain trials, additional data were recorded for specific information, e.g., response to coccidial challenge and hemagglutination inhibition tests.

During the past 5 years some 250 such field trials have been carried out in some 20 states from coast to coast in the United States. A total population in excess of one million birds has been included.

Results with Growing Birds

Chickens. The first work was carried out on broiler chicks because the largest need is in this type of poultry production. In 1952 when the first controlled field experiments on high-level feeding of Aureomycin were initiated, between 800 and 900 million broilers a year were being produced in the United States, representing an investment of approximately 1 billion dollars. Annual losses from C.R.D. alone were conservatively considered as

about 50 million dollars.[4]

Early experiments indicated that growth efficiency of birds infected by the intraocular route with a yolk-sac culture of pleuro-pneumonialike organism (PPLO) (23) was significantly suppressed as compared to that of non-inoculated controls prior to elaboration of a premortem syndrome of C.R.D.; but this effect was significantly reduced by Aureomycin in the diet at 50 and 100 g. per ton (41).

TABLE IV

EFFECT OF HIGH LEVEL AUREOMYCIN ON INTERIM (2 WEEK) YIELDS OF STRAIGHT-RUN NEW HAMPSHIRE CHICKS GROWN IN NEW AND USED BUILDINGS (10 × 300 PER GROUP)

(Pounds gain in weight at each period per thousand birds started. Percentage related to corresponding control group at each period.)

PERIODS AS WEEKS	GRAMS AUREOMYCIN IN DIET PER TON OF FEED							
	0		50		100		200	
		PERCENT OF WEIGHT BASAL		PERCENT OF WEIGHT BASAL		PERCENT OF WEIGHT BASAL		PERCENT OF WEIGHT BASAL
	lb.		*lb.*		*lb.*		*lb.*	
	A. New buildings							
0 to 2	293	100	298	101.7	293	100.0	300	102.4
2 to 4	660	100	653	98.9	664	100.6	670	101.5
4 to 6	811	100	869	107.2	878	108.3	890	109.7
6 to 8	734	100	696	94.8	731	99.6	695	94.7
8 to 10	606	100	716	118.2	745	122.9	778	128.4
Total weight marketed per 1000 chicks started	3148	100	3312	104.0	3391	106.5	3413	107.2
	B. Old buildings							
0 to 2	331	100	345	104.3	345	104.3	355	107.3
2 to 4	404	100	410	101.5	420	104.0	435	107.7
4 to 6	498	100	637	127.9	641	128.7	686	137.8
6 to 8	762	100	875	114.8	881	115.6	898	117.8
8 to 10	616	100	728	118.2	749	121.6	783	127.1
Total weight marketed per 1000 chicks started	2691	100	3075	114.3	3116	115.8	3237	120.3

Least Significant Difference of market yields at P = 0.05 — 126 lb.

in the results between antibiotic levels in the first experiment (A, Table IV) were more pronounced in the second experiment (B, Table IV). Presumably in the new surroundings general disease contagion was low for the first flock, but by the time the second flock was installed a heavy infection load was established and the effect of the antibiotic was thus greater in the second experiment. This is also indicated by the significant decline in the second basal series.

Table V gives the relative responses secured from thirteen commercial flocks grown under a variety of environmental and seasonal conditions. In general, Aureomycin at 50 to 100 g. per ton given on a continuous basis, enhanced market weight and quality, increased total yields of salable meat produced, reduced mortality, and improved feed conversion. This was particularly apparent in cases of definitive clinical disease — flocks 6 and 7.

Although Aureomycin is economically effective when fed on a prophylactic basis to chickens growing in areas of known endemic disease (cf. Table XIII), it can also be economically effective when fed therapeutically to flocks which sustain outbreaks of certain diseases (41).

Figure 1 illustrates the effect of continuous feeding of Aureomycin on the course of mortality suffered by a flock of broilers sustaining a natural outbreak of Newcastle disease. The antibiotic had no effect upon the virus infection *per se*, as indicated by the course of mortality among the Aureomycin-fed birds and by the fact that all birds, regardless of diet, developed the same Newcastle virus serum antibody titer. The antibiotic did, however, substantially reduce loss from intercurrent infection associated with the general debilitating process following the viral outbreak.

TABLE V

SUMMARY OF MARKET RESULTS OF THIRTEEN COMMERCIAL BROILER FLOCKS WHERE HIGH-LEVEL AUREOMYCIN WAS FED CONTINUOUSLY (Total No. of birds studied = 154,700 in 5 states)

ITEM	AUREOMYCIN, g/ton	FARM NUMBER, LOCATION (STATE), AND NUMBER OF BIRDS PER GROUP												
		1 Ga. 5000	2 Del. 4000	3 Miss. 2500	4 Pa. 2500	5 Ga. 3500	6[a] Pa. 2500	7[a] Md. 8000	8 Md. 5000	9 Del. 12,500	10 Ga. 5000	11 Ga. 5000	12 Ga. 10,000	13 Md. 8600
Market wt., lb.	None	2.89	3.10	2.36	3.37	2.84	3.08	2.84	2.78	2.92	2.78	3.06	2.94	2.89
	50	..	3.40	..	3.56	2.88	3.35	3.08	..	..	3.43	3.16	3.07	..
	100	3.08	3.40	2.66	..	..	3.56	..	2.91	3.01	..	..	..	2.96
Market wt. as % of control	50	..	109.7	..	105.6	101.4	108.8	108.5	..	..	123.4	103.3	104.4	..
	100	107.3	109.7	112.7	..	..	115.6	..	104.7	103.1	..	..	..	102.4
Yield, lb. per 1000 Birds Started	None	2513	2976	2270	3292	2655	2569	1477	2605	2756	2516	2947	2769	2774
	50	..	3301	..	3414	2776	2898	2156	..	..	3135	3046	2867	..
	100	2990	3295	2607	..	..	3247	..	2721	2944	..	..	..	2889
Yield as % of control	50	..	110.9	..	103.7	104.6	108.8	146.0	..	..	124.6	103.4	103.5	..
	100	118.9	110.7	114.8	..	..	126.4	..	104.5	106.8	..	..	..	104.1
Mortality, %	None	10.9	4.0	3.8	2.3	6.5	16.6	48.0	6.3	5.6	9.5	3.7	5.8	4.0
	50	..	2.9	..	4.1	3.6	13.5	30.0	..	..	8.6	3.6	6.6	..
	100	2.8	3.1	2.0	..	..	8.8	..	6.5	2.2	..	..	..	2.4
Mortality as % of control	50	..	72.5	..	178.3	55.4	81.3	62.5	..	..	90.5	97.3	113.8	..
	100	26.2	77.5	52.6	..	..	53.0	..	103.2	39.3	..	..	..	60.0
Feed : Gain	None	3.11	3.20	2.94	3.21	3.10	3.72	6.58	2.84	2.92	3.25	2.96	4.02	2.83
	50	..	3.10	..	3.22	2.83	3.40	4.61	..	..	2.79	2.98	3.89	..
	100	2.81	2.70	2.64	..	..	3.35	..	2.73	2.94	..	..	..	2.70
Feed : Gain as % of control	50	..	96.9	..	100.3	91.3	91.4	70.1	..	..	85.8	100.7	96.8	..
	100	90.4	84.4	89.8	..	..	90.1	..	96.1	100.7	..	..	..	95.4

[a] Serious outbreaks of acute virus disease.

Data from a large field experiment conducted in a relatively clean environment (newly constructed house near Gainesville, Georgia) and immediately repeated on the succeeding flock are presented by Table IV. Differences

Turkeys. Early mortality in poults is a major problem among turkey growers. Mortalities ranging from 10 to 30% are frequently encountered (13). Studies over a

[4] U.S. Department of Agriculture, Bureau of Animal Industry. Conference on chronic respiratory disease (mimeo. report). Washington, D. C. (March 1952).

2-year period with Beltsville small white poults indicated that two factors which can provoke substantial losses are a delay of more than 24 hours in feeding the newly-hatched birds, and installing the poults in unsanitary brooder pens. Losses from both these conditions can be markedly alleviated by feeding Aureomycin in the feed or water, or both, for 10 to 14 days following hatching. Table VI summarizes these findings.

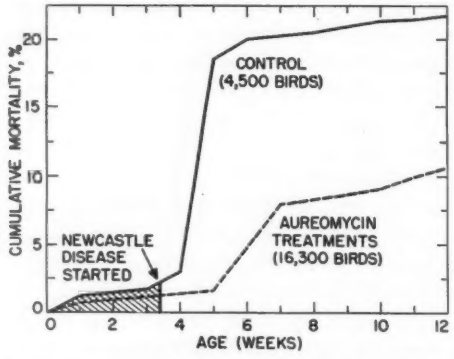


Fig. 1. Effect of Aureomycin in the diet on the course of mortality in a broiler flock which sustained an outbreak of Newcastle disease.

TABLE VI

EFFECT OF AUREOMYCIN IN FEED OR WATER ON EARLY GROWTH AND MORTALITY OF STRAIGHT-RUN BELTSVILLE WHITE TURKEY POULTS UNDER STRESS OF DELAYED POST-HATCH FEEDING AND UNSANITARY BROODING

(Quadruplicate groups of 30 each)

STRESS FACTOR	AVERAGE WEIGHT AT 21 DAYS PER POULT STARTED							
	Aureomycin in Feed				Aureomycin in Water			
	None	Mortality	30 g/ton	Mortality	None	Mortality	70 p.p.m.	Mortality
	lb.	*%*	*lb.*	*%*	*lb.*	*%*	*lb.*	*%*
Time to first feeding								
24 Hours	0.483	8	0.497	6	0.473	7	0.508	7
48 Hours	0.177	69	0.269	50	0.171	70	0.275	49
Brooding sanitation								
Clean	0.359	8	0.430	8	0.374	7	0.415	7
Dirty	0.302	30	0.337	23	0.271	25	0.368	28

Least significant difference in weight per bird at P = 0.01—0.049 lb.

Table VII indicates that continuous feeding of young growing turkeys with a diet containing 100 g. of Aureomycin per ton significantly increases bird weight, yield, and feed efficiency.

TABLE VII

EFFECT OF HIGH LEVEL AUREOMYCIN IN DIET ON GROWTH AND YIELD OF BELTSVILLE WHITE TURKEYS

(Duplicate groups of 100 each)

AGE	AUREOMYCIN IN DIET — g/ton			
	None		100	
	Weight	Feed : Gain	Weight	Feed : Gain
weeks	*lb.*		*lb.*	
6	2.80	2.33	2.95	2.10
8	3.41	2.62	3.65	2.33
10	5.35	2.86	5.81	2.59
12	6.16	2.98	6.53	2.78
14	7.44	3.26	7.79	3.11
16	8.61	3.53	9.05	3.46
Yield,[a] lb. per thousand	7623	..	8665	..

[a] Yield — pounds meat sold per 1000 poults started.

Ducks. An experiment conducted in the Long Island duck area indicated that White Pekin ducks respond favorably to continuous feeding of Aureomycin at a level of 100 g. per ton of diet from hatch to market, as indicated below:

Item	*Aureomycin in Diet*	
	None	100 g/ton
No. of birds started	600.0	650.0
Mortality to 8 weeks, %	16.5	10.9
Average dressed weight, lbs.	6.35	6.53
Feed-to-gain ratio	4.01	3.78

Results with Mature Birds

Laying chickens. Early work on the use of antibiotics in the diet of laying and breeding fowl showed no significant effects on egg production, feed-to-egg ratios, or hatchability (3, 9, 19, 36). This led to the general conclusion that antibiotics were of no value in production efficiency of laying fowl. The levels of antibiotic fed, however, were the so-called low nutritional levels of 4 to 10 p. p. m. of diet, which might not have any significant effect on large birds under practical farm levels of infection. A laying or breeding flock of body weight 5 to 6 lb. would consume feed at the rate of around 0.3 lb. per head per day. At 10 p. p. m. of antibiotic in the feed, this would represent a drug intake of approximately 0.05 p. p. m. of body weight per day, probably insufficient. Subsequent studies have revealed that higher levels of 50 to 200 p. p. m. of wide-spectrum antibiotic in the diet frequently do increase egg production, feed-to-egg ratio, and hatchability of laying fowl, particularly under stress conditions of disease or environment.

Thus Heywang (15) found that during excessively hot weather in Arizona, egg production and feed-to-egg ratio of White Leghorn hens was significantly increased and mortality decreased when 50 or 100 g. of Aureomycin were included in the mash.

Camp and Couch[5] noted substantial increases in egg production and hatchability when Aureomycin at high levels (100 to 200 g/ton) was added to the diet of laying hens showing severe depression in production and hatchability, even though no clear-cut diagnosis of clinical disease was made.

Carlson (10) divided a flock of layers into low and high producers and fed Aureomycin at 50 to 100 g. per ton of diet to each. The antibiotic induced a significant increase in egg production and an improvement in feed-to-egg ratio in the low but not in the high producers.

Our experiments in this field began in January 1953. Figure 2 presents the relative difference in egg production of 3000 New Hampshire breeder hens, which had been in production over 4 months and were suffering a severe outbreak of C.R.D. at the time the treatment of 100 g. of Aureomycin per ton of total diet (i.e., mash plus grain) was initiated on half the flock. Production of the 1500 unsupplemented control birds was around 30% at the start and remained approximately constant during the 42 days of the trial.

A second experiment involved a commercial flock of 2000 Vantress breeders divided into groups which received the three treatments — nil, 50, and 100 g. of Aureomycin per ton of total diet continuously — immediately

[5] Camp, A. E., and Couch, J. R. Personal communication (1955).

following blood testing for pullorum disease at about 25% production. Production following initiation of treatment rose rapidly in eggs laid per 100 hens daily for the Aureomycin-treated birds. In the middle of the season the differences between the control and treated birds were negligible, while at the terminal period the groups at the 100-g. level again showed a higher production rate.

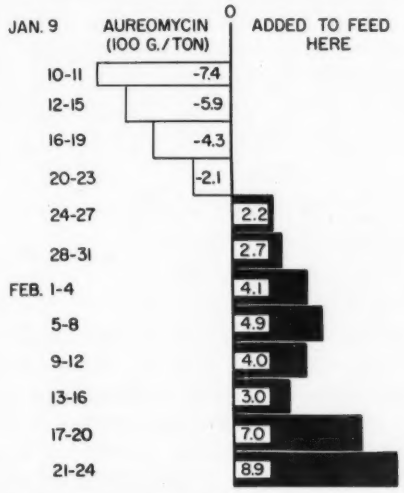


Fig. 2. Difference in per cent egg production (under and over normal production, at 0) of a flock of Vantress breeders infected with C.R.D., following addition of 100 g. of Aureomycin per ton of total ration.

Table VIII gives the summarized data from this trial. Aureomycin at 50 g. per ton did not improve the over-all production or the feed-to-egg ratio; it did, however, increase hatchability with a resulting increased economic return. At 100 g. per ton, Aureomycin significantly enhanced production, feed-to-egg ratio, hatchability, and economic return. This flock had sustained an outbreak of C.R.D. as growing pullets (12 to 18 weeks old) and as the breed had large body weight (5 to 7 lbs.) it appears a level of dietary antibiotic of at least 100 g. per ton was required for significant effect.

TABLE VIII

EFFECT OF FEEDING HIGH-LEVEL AUREOMYCIN AT VARIOUS LEVELS TO VANTRESS BREEDER HENS OVER AN 11-MONTH PERIOD

(2 × 330 hens started per group)

ITEM	AUREOMYCIN IN TOTAL DIET, G/TON		
	None	50	100
Production, %	43.8	42.2	48.5
Eggs per hen housed	116.0	114.0	126.0
Average hatchability, %	79.0	83.4	83.3
Grade I chicks per hen housed	92.0	95.0	105.0
Increase over control	...	...	10.0
Feed per dozen eggs, lb.	6.06	6.29	5.76
Probability of differences of production %		P=.04	$P=10^{-4}$

Table IX gives production records of White Leghorn hens over a period of 12 months when fed Aureomycin continuously at 50 g. per ton for three different periods:

(a) Control — no antibiotic.
(b) Entire period, from hatch to end of experiment.
(c) Growing only — hatch to first egg.
(d) Laying only — first egg to end of experiment.

The over-all production averages show a highly significant though numerically small increase in production for groups (b) and (c), but not for (d), as compared with the controls. The health of this flock appeared to be excellent, and egg production by the control group was high. Nevertheless, feeding the antibiotic during the developmental period was followed by increased production. Production appeared to be increased by the antibiotic, particularly in the early and late stages of the laying season.

TABLE IX

EGG PRODUCTION OF WHITE LEGHORN HENS FED 50 g. AUREOMYCIN PER TON RATION FOR VARIOUS PERIODS IN NORTHERN NEW JERSEY

(Data eggs per 100 hens per day; 6 × 65 hens started per group)

MONTH	PERIOD OF FEEDING AUREOMYCIN			
	None	Entire Life	Growing Only	Laying Only
January	55.6	60.8	56.5	56.1
February	83.5	85.8	84.2	79.8
March	79.2	81.1	81.5	80.6
April	76.4	80.4	77.0	80.6
May	72.0	76.2	75.7	74.7
June	74.4	71.8	73.0	72.9
July	68.7	71.9	70.2	71.8
August	62.5	68.5	68.1	68.4
September	58.0	66.3	65.6	65.4
October	57.8	61.6	64.4	59.8
November	54.3	58.4	59.8	53.4
December	48.1	54.9	53.4	44.9
Average	65.9	69.8	69.1	67.3
Probability of production % differences		P=.01	P = .05	P<.05

A series of laying flock trials were conducted in Utah in cooperation with commercial growers. Table X summarizes these results. Egg production and feed-to-egg ratio

TABLE X

SUMMARY OF PRODUCTION RESULTS FROM FOUR FLOCKS OF WHITE LEGHORN HENS FED VARIOUS LEVELS OF AUREOMYCIN CONTINUOUSLY

(Exp. 977-54-42)

FLOCK NO.	AUREOMYCIN IN DIET, g/ton			
	None	50	100	200
1–2 × 300/group Production period: July – July				
Average production %	54.4	55.4	60.2	
Cases/M housed	498	518	580	
Feed: Egg ratio	5.98	5.80	5.71	
Probability of production % differences		P = 0.06	P = 0.03	
2–2×250/group Production period: July – July				
Average production %	57.8		69.2	
Cases/M housed	481		601	
Feed: Egg ratio	4.76		4.47	
Probability of production % differences			$P = 1 \times 10^{-4}$	
3–2×260/group Production period: Oct.–July				
Average production %	58.9	60.8	61.8	62.1
Cases/M housed	401	421	420	420
Feed: Egg ratio	6.03	5.85	5.66	5.66
Probability of production % differences		P = 0.03	$P = 1 \times 10^{-3}$	$P = 1 \times 10^{-4}$
4–2×280/group Production period: Oct.–July				
Average production %	67.8	69.4	71.1	
Cases/M housed	478	487	500	
Feed: Egg ratio	4.73	4.60	4.34	
Probability of production % differences		P = 0.09	P = 0.01	

of all the flocks fed 100 – 200 g. of Aureomycin per ton of diet were better than for the control groups. These improvements were in all cases economically valid at the time (1954–1955) of the trials.

Breeding turkeys. A series of trials on the use of Aureomycin in the breeder diet of Beltsville White turkeys have shown that levels of the antibiotic of 100 and 200 g. per ton of diet fed during the 110-day breeding period

significantly increased egg production, hatchability, and numbers of No. 1 grade poults produced per hen (42).

Interrelations

The specific interrelations of antibiotic feeding, particuuarly at high level, to other environmental factors are as yet largely obscure.

That many such interactions may occur has already been indicated in the data presented for young poults in terms of stress environments. Other possible interactions for antibiotics when fed at high levels include:

(a) Relation to nutrients such as protein (quality and quantity), vitamins, minerals and energy sources.

(b) Relation to dietary medicaments such as anticoccidial drugs, nematocides, arsenicals, etc.

(c) Relation to vaccination.

Protein requirement. Early work on the relation of protein requirement at low-level antibiotic feeding indicated a possible "sparing" effect (21, 38, 39). Other workers concluded that no sparing effect of antibiotics on protein occurred in chicks (4, 19, 24, 30, 31, 33). In studies involving both low and high levels of Aureomycin, however, we have found that low levels (10 p. p. m. of diet) gave the maximum antibiotic effect on growth at a low level of protein (16%), whereas the high level (100 p. p. m.) of antibiotic gave the maximum effect at 22% protein. In all cases, energy level was held constant at 900 to 950 calories per pound of diet. Table XI summarizes these data.

TABLE XI

RELATION OF HIGH-LEVEL AUREOMYCIN TO PROTEIN LEVEL OF DIET IN GROWTH OF NEW HAMPSHIRE CHICKS

(Data in lb/bird at 12 weeks; 2 × 300 chicks/group)

PROTEIN IN DIET	AUREOMYCIN IN DIET, g/ton				
	None	10	50	100	200
%					
16	2.84	3.01	3.02		
18	2.92	3.07	3.11		
20	2.94	3.09	3.40		
LSD	P = 0.05 0.21		P = 0.01 0.28		
20	3.31	3.27	3.50	3.60	3.61
22	3.31	3.40	3.58	3.51	3.48
24	3.31	3.14	3.39	3.53	3.48
LSD	P = 0.05 0.29		P = 0.01 0.40		

Exp. 977-53-36; 54-4

Vitamins. Many studies have indicated a vitamin-sparing effect of antibiotics in the diet at low level (6, 7, 16, 35; 17 for reviews).

No results, as yet, have been published on the effect of high-level feeding of antibiotics on vitamin requirements. Experiments made under both "clean" and "dirty" conditions on the possible interaction of high-level Aureomycin on the response to added levels of niacin, riboflavin, pantothenic acid, and folic acid, individually and all four combined are summarized in Table XII. No significant increases were produced by any of the vitamin supplements, even under the dirty conditions where the growth effect of the antibiotic was significant. This would suggest that insofar as these particular vitamins are concerned the high level antibiotic did not increase the vitamin requirement beyond the levels in our basal diet.

TABLE XII

RELATION OF AUREOMYCIN TO EXCESS B-COMPLEX VITAMINS TO GROWTH OF NEW HAMPSHIRE STRAIGHT RUN CHICKS RAISED ON CORN COB LITTER OF VARIED AGE

(2 × 200 chicks/group)

VITAMIN SUPPLEMENT	WEIGHTS AT 10 WEEKS PER BIRD STARTED								
	NEW LITTER			OLD LITTER			ACROSS LITTERS		
	Aureomycin			Aureomycin			Aureo.	Across	
	10g/T	50g/T	Av.	10g/T	50g/T	Av.	10g/T	50g/T	Aureo.
	lb	lb	lb	lb	lb	lb	lb	lb	lb
Basal	3.14	3.18	3.16	2.90	3.03	2.97	3.02	3.11	3.07
High[a] niacin (N)	3.21	3.24	3.23	2.84	2.99	2.91	3.03	3.12	3.08
High pantothenate (P)	2.99*	3.18	3.09	2.95	2.99	2.97	2.97	3.09	3.03
High Riboflavin (R)	3.16	3.02*	3.09	3.00	3.03	3.01	3.08	3.03	3.06
High folic (F)	3.08	3.13	3.10	2.80	2.97	2.89	2.94	3.05	2.99
High N+P+R+F	3.15	3.21	3.18	2.93	2.96	2.95	3.04	3.09	3.07
Average	3.12	3.16	3.14	2.90	3.00**	2.95**	3.01	3.08**	3.05
LSD at P = 0.05* 0.01** S. E. single			0.09						
Between litters (L)				*0.04	**0.05				
Between Aureomycin (A)				0.04	0.05				
Between vitamins (V)				0.07	0.09				
Interactions L × A				0.05	0.07				
L × V & A × V				0.09	0.13				
L × A × V				0.13	0.18				

[a] High indicates 3 × basal (NRC) level.

977-53-8 & 18

Minerals. Some work has been reported on the interrelation of antibiotics, at low level, to mineral nutrition in chicks with respect to calcium metabolism (5, 12, 27), phosphorus metabolism (20), and manganese requirement (28). The findings suggest that mineral utilization was enhanced by low levels of Aureomycin and penicillin in the diet. No data relative to the effect of high-level feeding of antibiotics on mineral metabolism are as yet reported.

There is some evidence that antibiotics at low levels increase the rate of absorption of certain nutrients from the intestine (17), so that it might be expected that high levels of antibiotics would significantly improve the growth on low-energy rations (700–750 calories/lb) to a greater extent than on high-energy diets (900–950 calories/lb). The table below indicates that this effect was observed in growing chicks.

Relation of High-Level Aureomycin feeding to Diet Energy in Growth of Straight-Run New Hampshire Chicks at 56 days

(2 × 200 chicks/group)

Diet Energy	Aureomycin in diet, grams per ton		
	None	100	Average
Calories/lb	lbs.	lbs.	lbs.
750	2.87	2.97	2.92
950	3.07	3.13	3.10
Average	2.97	3.05	

LSD at P = 0.05—0.21

977-54-49

A factorial experiment involving diet energy level across 0, 10, and 100 g. of Aureomycin per ton of complete diet carried out by Bearse and Berg (2) on White Leghorn layers indicated that the high-level antibiotic enhanced egg production and feed-to-egg ratio on both the high-energy and low-energy diets, while the low-level antibiotic (10 g/ton) enhanced production only on the low-energy diet.

In our experiments with White Leghorn layers, two energy levels of diet were employed, with only one a high level of antibiotic, i.e., 50 g. of Aureomycin per ton. The antibiotic increased egg production at both energy levels, but improved feed-to-egg ratio only on the high-energy diet.

Relation to Dietary Medicaments

No published information is available on the possible interaction of antibiotics at high level with other dietary medicaments. We have carried out a number of experiments on this subject both under battery and field conditions. Several significant interactions appear to occur, some positive, others negative, between the various antibiotics and anticoccidial drugs now in commercial usage.

One point appears certain from the evidence obtained to date. It cannot be assumed that the addition of an antibiotic and another medicament in a diet will always produce a simple additive effect. There may be significant interactions and these may be negative in certain cases.

Relation to Vaccination

It has been suggested (32, 34, 37) that antibiotic feeding might interfere with development of immune response to vaccination for viral infections. This possible interrelation is of significant importance to the commercial poultryman, who must vaccinate to protect from Newcastle disease, infectious bronchitis, laryngotracheitis, and fowl pox. Recently, however, Markham *et al.* (22) have presented evidence that immunity to Newcastle disease and infectious bronchitis was not modified by the continuous feeding of Aureomycin at levels from 10 to 300 g. per ton either prior to, during, or after the vaccination process. Markham and coworkers conclude there is no evidence that dietary Aureomycin would interfere with immune response to these virus diseases.

Discussion

From the experimental evidence on the effect of high-level feeding of Aureomycin to poultry a tentative hypothesis can be proposed as to the effect of the antibiotic under practical conditions.

The evidence is in favor of the disease-control mechanism as the main effect of antibiotics in animal nutrition. High-level continuous feeding of Aureomycin maintains a constant and, in general, adequate level of drug intake effective against a wide spectrum of known and presumably unknown microflora. Continuous suppression of these microflora may reduce over-all nutritional competition and diminish the invasion of primary pathogens sensitive to the antibiotic, or of secondary agents capable of accentuating the effects of other acute disease pathogens not in themselves sensitive to the antibiotic, such as Newcastle disease virus.

In cases of chronic disease such as C.R.D., the primary infecting agent may cause a subclinical state for prolonged periods. During such periods of slow or delayed incubation the host may not be seriously sick or apparently morbid, but the debilitating effect of the pathogen may reduce growth and production efficiency. It may do so, with severe economic loss, without inducing a marked increase in the rate of mortality or in the appearance of frank signs of disease. Under such circumstances no therapy would normally be applied, and any reduction in the yield of meat would not become apparent until the marketing of the flock.

TABLE XIII

SUMMARY OF FLOCK RECORDS FOR 1952-54 OF 128 FLOCKS OF BROILER CHICKS IN THE DELMARVA AREA AS RELATED TO USE OF AUREOMYCIN

ITEM	NONE	SPOT[a]	CONTINUOUS[b]
No. of flocks recorded	50	40	38
Total number of birds	552,000	356,000	315,000
Mortality, %	10.6	7.5	5.4
Av. market wt. in lb. (84 days)	3.19	3.20	3.52
Yield/1000 started — lb.	2846	2956	3313
Feed conversion	3.31	3.10	3.01
Probability of yield differences	....	$P = 0.001$	$P = 1.0 \times 10^{-9}$

[a] Levels of 100 to 200 g/ton fed therapeutically for periods of 5-10 days once or twice.
[b] Levels of 50 to 100 g/ton fed continuously.

The use of continuous high-level Aureomycin for both broiler (meat) birds and laying birds has been found to reduce such losses, particularly in areas of concentrated production and known endemic disease. A statistical summary (Table XIII) of results with some 128 commercial flocks involving over 1,200,000 birds clearly indicates the economic validity of the continuous feeding of high level Aureomycin to growing birds in such concentrated areas.

Summary

Experiments on the use of high levels of Aureomycin (50 p. p. m. of diet and up) are reported on a total population of birds aggregating 1,472,000, divided as follows:

234,000 on controlled broiler flocks
1,223,000 on commercial broiler flocks
13,000 on laying and breeding hens
2,400 on meat turkeys
1,250 on meat ducklings

These experiments have been carried out over a wide range of environmental conditions of season and location, including New York, New Jersey, Delaware, Maryland, Pennsylvania, Georgia, Mississippi, Alabama, Virginia, Utah, and California.

The results have indicated that continuous or prophylactic feeding of Aureomycin at levels of 50 to 200 g. per ton of total diet produced significant increases in growth rate, livability, meat yield, quality, and feed conversion among growing chickens, turkeys, and ducks, and improved egg production and feed-to-egg ratios in laying and breeding chickens and turkeys. These advantages were particularly apparent under conditions of endemic diseases of an acute and/or a chronic etiology.

In a chronic disease such as chronic respiratory disease, there appeared to be a direct action of the drug resulting in a significant decline in the severity of the syndrome and its concomitant depression of the growth efficiency of the host.

The drug was found to have no direct effect upon acute viral diseases such as Newcastle disease, but it did significantly reduce secondary infection and its associated damage.

No cases of toxicity were encountered at any of the levels of Aureomycin fed. No interruption of normal growth or reproduction occurred.

Acknowledgment

The authors wish to express their appreciation to the many growers, feed men, hatchery operators, and feed manufacturers who cooperated in the management and operation of these experiments. Particularly do we wish to thank Mr. Leon F. Trivits, Seaford, Del.; Mr. L. Edd. Travis, Gainesville, Ga.; Messrs. Parker, Sandy, Utah; Mr. Robert Crile, Greenwood, Va.; Mr. Ralph Holder, Miller & Bushong, Rohrerstown, Pa.; Dr. E. Bechtel and Mr. Earl Wood, General Mills, Detroit, Mich.; Mr. Milton Hendrixson, Kentucky Chemical Industries, Cincinnati, Ohio; Mr. Meade Summers, Ralston Purina Co., St. Louis, Mo.; Mr. H. Halloran, Poultry Producers of Central California, Petaluma, Calif.; and Mr. W. Allen, Allen's Hatchery, Seaford, Del.

We also thank Drs. T. H. Jukes and E. L. R. Stokstad for guidance and encouragement, and Mr. Bernard McConville for his tireless computation in the statistical analysis of the data.

Literature Cited

1. ANONYMOUS. The fifth year of Aureomycin. Lederle Labs. Div., American Cyanamid Co.: New York (1954).
2. BEARSE, G. E., and BERG, L. R. Poultry Sci. **34**: 1180 (1955).
3. BERG, L. R., CARVER, G. S., BEARSE, G. E., and MCGINNIS, J. Wash. Agr. Exp. Sta. Bull. 534 (May 1952).
4. BIELY, J., MARCH, B. E., and SMITH, D. F. Poultry Sci. **31**: 863–870 (1952).
5. BOGDONOFF, P. D., JR., and SHAFFNER, C. S. Poultry Sci. **33**: 665–669 (1954).
6. BRAUDE, R., KON, S. K., and PORTER, J. W. G. Nutrition Abstracts & Revs. **23**: 473–495 (1953).
7. BRIGGS, G. M. Trans. Am. Assoc. Cereal Chemists **10**: 31–50 (1952).
8. BROQUIST, H. P., and KOHLER, A. R. Antibiotics Annual, 1953–54, pp. 409–415.
9. BROWN, J. A., ROBBLEE, A. R., and CLANDININ, D. R. Poultry Sci. **32**: 576–578 (1953).
10. CARLSON, C. W., and KOHLMEYER, W. (Abstr.) Poultry Sci. **33**: 1047 (1954).
11. CATRON, D. V., JENSEN, A. H., HOMEYER, P. G., MADDOCK, H. M., and ASHTON, G. C. J. Animal Sci. **11**: 221–232 (1952).
12. GABUTEN, A. R., and SHAFFNER, C. S. (Abstr.) Poultry Sci. **31**: 917 (1952).
13. HARPER, J. A., and BABCOCK, W. E. Poultry Sci. **32**: 179–180 (1953).
14. HEUSER, G. F., and NORRIS, L. C. Poultry Sci. **31**: 857–862 (1952).
15. HEYWANG, B. W. Poultry Sci. **33**: 1059 (1954).
16. JUKES, T. H., and WILLIAMS, W. L. Pharmacol. Revs. **5**: 381–420 (1953).
17. JUKES, T. H. Antibiotics & Chemotherapy Monograph Series No. 4 (1955).
18. KRAMKE, E. H., and FRITZ, J. C. (Abstr.) Poultry Sci. **30**: 921 (1951).
19. LILLIE, R. J., and BIRD, H. R. Poultry Sci. **32**: 531–535 (1953).
20. LINDBLAD, G. S., SLINGER, S. J., and MOTZOK, I. Poultry Sci. **33**: 482–491 (1954).
21. MACHLIN, L. J., DENTON, C. A., KELLOGG, W. L., and BIRD, H. R. Poultry Sci. **31**: 106–109 (1952).
22. MARKHAM, F. S., PRICE, R. J., SEEGER, K., and WHITE-STEVENS, R. Poultry Sci. **34**: 554–559 (1955).
23. MARKHAM, F. S., and WONG, S. C. Poultry Sci. **31**: 902–904 (1952).
24. MATTERSON, L. D., SINGSEN, E. P., DECKER, LOIS, and KOZEFF, ANNA. (Abstr.) Poultry Sci. **31**: 940 (1952).
25. MCGINNIS, J., BERG, L. R., STERN, J. R., WILCOX, R. A., BEARSE, G. E. (Abstr.) Poultry Sci. **29**: 771 (1950).
26. MCGINNIS, J., STERN, J. R., WILCOX, R. A., CARVER, J. S. Poultry Sci. **30**: 492–496 (1951).
27. MIGICOVSKY, B. B., NEILSON, A. M., GLUCK, M., and BURGESS, R. Arch. Biochem. **34**: 479–480 (1951).
28. PEPPER, W. F., SLINGER, S. J., and MOTZOK, I. Poultry Sci. **31**: 1054–1061 (1952).
29. RUNNELS, T. D., REYNOLDS, G. W., and WALLER, E. F. (Abstr.) Poultry Sci. **30**: 929 (1951).
30. SAXENA, H. C., STARR, MILDRED E., BLAYLOCK, L. G., CARVER, J. S., and MCGINNIS, J. Arch. Biochem. **44**: 346–350 (1953).
31. SCOTT, H. M., GOFFI, E. A., and GLISTA, W. A. Poultry Sci. **31**: 751–752 (1952).
32. SLANETZ, C. A. Antibiotics & Chemotherapy **3**: 629–633 (1953).
33. SLINGER, S. J., BERGEY, J. E., PEPPER, W. F., SNYDER, E. S., and ARTHUR, D. Poultry Sci. **31**: 757–764 (1952).
34. STEVENS, K. M. J. Immunol. **71**: 119–124 (1953).
35. STOKSTAD, E. L. R. Physiol. Revs. **34**: 25–51 (1954).
36. WAIBEL, P. E., SUNDE, M. L., and CRAVENS, W. W. Poultry Sci. **31**: 621–624 (1952).
37. WALLER, E. F. Feed Age **3**(11): 34 (1953).
38. WEAKLEY, C. E., JR., HARE, J. H., ANDERSON, G. C., BLETNER, J. K., and MASON, G. A. (Abstr.) Poultry Sci. **32**: 927 (1953).
39. WEST, J. W., and HILL, J. E. Poultry Sci. **34**: 628–634 (1955).
40. WHITE-STEVENS, R. Feedstuffs **26** (13): 42–44, 46, 48 (March 27, 1954).
41. WHITE-STEVENS, R., and ZEIBEL, H. G. Poultry Sci. **33**: 1164–1174 (1954).
42. WHITE-STEVENS, R., ZEIBEL, H. G., and SMITH, F. Continuous high level feeding of Aureomycin in commercial poultry production. Paper before American Cyanamid Poultry Pathology Conference, Bear Mountain, New York, November 1954. Pub. by Fine Chemicals Division, American Cyanamid Co., New York (1954).

ERRATUM

Cereal Science Today, Vol. 1, No. 1

(May 1956 issue)

"Frozen bakery products," by William H. Cathcart, page 14: Figures 9 and 10 are transposed.

FOOD TECHNOLOGIST—
THIS IS A GOOD
CHECK-LIST TO KEEP
FOR FUTURE REFERENCE!

Procter & Gamble has a Food Fat for Your Product

Here are the food fats which are available, a brief description of their physical characteristics, and their major applications in the food processing industry.

BRAND	PHYSICAL CHARACTERISTICS	MAJOR FOOD APPLICATIONS
PRIMEX	A plastic hydrogenated vegetable shortening.	All purpose baking, frozen pies, frying, frozen waffles, icing bases.
PRIMEX B&C	A plastic hydrogenated vegetable shortening of the long-keeping type.	Commercial frying, prepared mixes, cookies, and other food usages where a very stable fat is preferred.
SWEETEX	A plastic hydrogenated vegetable shortening containing mono and diglyceride emulsifiers.	Cakes, icings, whipped toppings, icing bases, sweet yeast goods and prepared mixes.
NUTEX	A plastic hydrogenated vegetable shortening of the long-keeping type and containing mono and diglyceride emulsifiers.	Icing mixes, prepared mixes, and other general food usages requiring the services of a very stable emulsifier type fat.
DUEX	A plastic mono and diglyceride concentrate made from hydrogenated vegetable oils.	Bread and sweet dough softener and in other application requiring food fat emulsifiers.
PERTEX	A plastic hydrogenated shortening made from directed rearranged meat fats, and vegetable oils.	All purpose baking, frozen pies, frozen waffles, icing bases and frying.
SELEX	A plastic hydrogenated shortening made from directed rearranged meat fats, and vegetable oils, with mono and diglycerides added.	Cakes, icings, sweet yeast goods, whipped toppings, prepared mixes.
ORO	A plastic shortening made from meat fats and hydrogenated vegetable oils.	Commercial frying and any other general food applications.
SILVER FROST	A plastic hydrogenated vegetable fat with relatively low melting characteristics.	Mellorine* (frozen dessert), whipped toppings, fillings, confectionery. *For sale in those states where mellorine is legal.
FLAKEWHITE	A plastic vegetable shortening.	Wholesale pies, cookies, frying.
ONESTA HARDENER	A completely hydrogenated peanut oil product (high melting point) in flaked form.	Peanut butter stabilizer, hardener and special lubricant in food products.
FIX AND FIX-M	Semi-fluid, pumpable preparations of specially processed peanut fats with salt added.	Peanut butter stabilizers.
PURITAN OIL	Especially winterized cottonseed salad oil.	Mayonnaise, salad dressings, frying and other uses requiring a liquid food fat.
MOONSTAR	Refined coconut oil, 76° type.	Spraying crackers and snacks, frying nuts and popcorn, ice cream coatings, and in confectionery uses.
STERLING	A plastic hydrogenated vegetable fat, chiefly coconut oil.	Fillings, icing bases, confectionery, whipped toppings, etc.

If you have a food fat problem connected with one of your present products, or with a product you are now developing, why not save time and money by consulting with our food technologists? They will be happy to work with you in the selection and use of the best food fat to meet your specific requirement.

For information please write to

FOOD PRODUCTS SERVIC
M. A. & R. BUILDING
THE PROCTER & GAMBLE COMPANY,
IVORYDALE, OHIO

the President's Corner

news of the association

I am happy to report that all committee appointments for the current Association year have been made and are to be announced in the October issue. There are 18 nontechnical and 17 technical committees. Total committee membership is more than 250. This is indeed an impressive indication of the interest of our membership in the affairs and endeavors of our Association.

Much of the progress of our Association of interest to the scientific world and of benefit to the cereal industry and the public will result from efforts of our various technical committees. Technical committee chairmen and members have been chosen carefully and consist only of Association members who have special interests in the problems of their respective committees and who are in a position to contribute to committee activities. The work of the various technical committees is integrated by the Technical Policy Committee under the capable chairmanship of Dr. John A. Johnson. All technical committee chairmen are members of the Technical Policy Committee.

The technical committee chairmen are engaged also in review of the galley proofs of *Cereal Laboratory Methods*. Thus, they not only share in the responsibility of developing new and useful methods, but play an important part in seeing the methods compiled in a useful book.

Every effort is being made to further strengthen the important work of our technical committees. Although some restrictions must be imposed on the size and make-up of committees, Dr. Johnson would be glad to learn of anyone who is interested in participating in the work of any of our technical committees and who has the time and facilities to do so. Active Association members and authorized representatives of corporate members are eligible for committee membership. Other interested persons may serve as collaborators when additional collaborators are needed.

If any of you readers have ideas concerning worthwhile projects that should be undertaken by our present technical committees or concerning the establishment of new committees, you are urged to communicate with Dr. Johnson. It is through this kind of cooperation that we can expect to make more rapid progress toward our goals.

LAWRENCE ZELENY

Per pound of actual monoglyceride, no emulsifier you can get is less expensive than Myverol® Distilled Monoglycerides. And monoglycerides are what do the work.

Myverol Distilled Monoglycerides are available in bulk from most common fats and oils. For information, write ***Distillation Products Industries,*** Rochester 3, N. Y. Sales offices: New York, Chicago, and Memphis • W. M. Gillies and Company, Los Angeles, Portland, and San Francisco • Charles Albert Smith Limited, Montreal and Toronto.

distillers of monoglycerides made from natural fats and oils

DPi

Also . . . vitamin A in bulk for foods and pharmaceuticals

Distillation Products Industries
is a division of **Eastman Kodak Company**

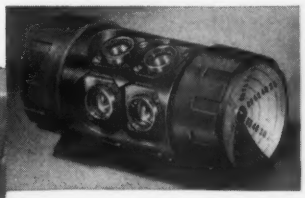
CYCLOPTIC

SPENCER

AMERICA'S NEWEST and FINEST STEREOSCOPIC MICROSCOPE

OUTSTANDING FEATURES

True three-dimensional erected image
Top quality optics . . . low reflection coated
Reversible and inclined body
Long working distance
Large field of view
Wide range of magnifications
Broad selection of models
Dove-gray EPOXY finish
Advanced styling and design
LOW PRICE
Plus
Revolutionary MAGNI-CHANGER



Desired magnifications simply "dialed-in" by rotation of calibrated cylinder

MANUFACTURER OF THE WORLD'S MOST MODERN . . . VERSATILE . . . AND COMPLETE LINE OF STEREOSCOPIC MICROSCOPES

†T. M. Reg. by American Optical Co.

American Optical

INSTRUMENT DIVISION, BUFFALO 15, N. Y.

NEW BROCHURE JUST OFF THE PRESS . . . WRITE FOR YOUR COPY

Dept. 000
Gentlemen:
Rush new CYCLOPTIC brochure, SB56

Name _____

Address _____

City _____ Zone ____ State ____

. . . People

David A. Buckley joins R. T. Vanderbilt Co. research labs in East Norwalk, Conn.

Lyle P. Carmony named Minneapolis district manager for Sterwin Chemicals, Inc. Mr. Carmony has been with Sterwin since 1947 and has recently served as district manager for the St. Louis area. He is a graduate of Kansas State College and an active member of the A.A.C.C.

Richard T. Cotton, Agricultural Marketing Service entomologist, was presented on July 2 with one of the National Civil Service League's ten annual service awards, given to career employees who "have exemplified in an outstanding manner . . . competence, efficiency, character, and continuity of service." Dr. Cotton is recognized as a world authority on insects that attack stored grain and cereal products.

C. C. Fifield, Senior Baking Technologist, USDA Field Crops Research Branch, Beltsville, has been in Peru (recently returned) as consultant to wheat improvement program, giving technical assistance in the chemical-milling-baking lab at La Molina Experiment Station near Lima. An objective—installing and using accepted and standard techniques for adequate evaluation of quality of bread grains developed in Peru. A Peruvian college-trained cereal technologist heads a staff of six in the lab, which has the usual cereal testing equipment.

Robert L. Glass joins staff of Dept. of Agr. Biochemistry, University of Minnesota, St. Paul, as Assistant Professor; will work in cereals section under **W. F. Geddes.**

Ernest Hart elected president of Food Machinery & Chemical Corp., San Jose, Calif.

C. G. Harrel appointed director of new products idea department of Pillsbury Mills Inc., Minneapolis, under direction of **G. R. Detlefsen.** Mr. Harrel came to Pillsbury in 1932 as director of product control and bakery research; later served as director of the research lab and as associate director of research and product development, before taking over directorship of food research in 1952. **Howard E. Bauman** is now head of the food research branch, the position formerly held by Mr. Harrel. Dr. Bauman came to Pillsbury in 1953 directly from the University of Wisconsin where he obtained his graduate degrees.

Dr. H. M. R. Hintzer, director of the Cereals Department of the Central Institute for Nutrition Research T.N.O. at Wageningen, The Netherlands, died on May 12 after a long illness, at the age of 42.

Dr. Hintzer was a distinguished European scientist whose early death is a great loss to the cereal profession. He began research work in nutrition soon after finishing his chemical studies at the University of Utrecht, and when the Central Institute was founded in 1946 he was named head of the Cereals Department. Under his leadership the department developed rapidly and it is now among the foremost institutions of its kind.

Dr. Hintzer attended the 39th annual meeting of the A.A.C.C. in Denver in May 1954 and took part in the program. Several of his articles appeared in **Cereal Chemistry** between 1949 and and 1955. He had accepted an invitation to serve as Corresponding Editor for **Cereal Science Today,** but his illness and death came before he could make any contributions.

Frank C. Hildebrand, director of products control at General Mills, has been elected a vice-president of the company, Minneapolis. He has been with General Mills since 1935.

Herbert A. Hollender promoted to associate director for research and radiation preservation for the food laboratories at Quartermaster Food and Container Institute for the Armed Forces, Chicago.

Jess A. Meininger, manager of Victor Chemical Works' technical service department for the milling industry, was honored recently at a company dinner for 25-year employees, receiving an engraved gold watch as a token of the company's appreciation.

Enrico T. Palomba named plant manager at Anheuser-Busch's yeast plant No. 2, Old Bridge, N. J., from assistant plant manager for the past eight years. Previous positions with A-B from 1937 were: laboratory control chemist, research chemist, and chief chemist, then in production department as supervisor, production manager, and technical manager. Mr. Palomba's A.A.C.C. affiliations have taken him through all offices in the New York Section; he was chairman of the local arrangements committee for the 1956 meeting.

Frank W. Perry named manager of domestic starch department at Stein, Hall & Co., New York.

Saul H. Rubin now director of applied research at Hoffman-La Roche, Inc., Nutley, N. J.; formerly director of applied research. **William R. Sullivan,** former assistant to the director of chemical research, promoted to general secretary of research.

J. A. Shrader, Ky. Agr. Exp. Sta., Lexington, Ky., elected president of the American Association of Feed Microscopists; others named were: **C. W. Roelle,** Kasco Mills Div. Corn Products Sales Co. as vice-president; **G. M. Barnhart,** Mo. State Dept. of Agr., Jefferson City, Mo., as secretary-treasurer. Named to the executive committee: **A. W. Creswell, E. F. Budde, R. L. Willis,** and **L. C. Radtke.**

. . . Patter

Mr. M. F. Lawatsch, Gen. Mills, Inc., Indianola, Iowa, presented a short "Demonstration on Feed Microscopy" during the program at the Poultry Science meeting held at N. C. State College, Raleigh, N. C., on August 9. Mr. Lawatsch is a member of the Education and Publicity Committee of the Am. Assoc. of Feed Microscopists.

• • •

Archer-Daniels-Midland has purchased a half-interest in Applied Radiation Corp., a producer of linear electron accelerators and other electronic equipment. ADM, a large

processor of agricultural crops and marine oils, is also a major producer of chemicals.

ADM points out that radiation processing promises to become one of the most important phases of atomic energy. Its use for cold sterilization of foods and pharmaceuticals has attracted considerable study. ADM believes that linear electron accelerators are likely to be one of the principal sources of such radiation.

"Our interest in the commercial utilization of atomic energy stems from the nature of ADM's operations," a company spokesman says. He points out that a large portion of the company's products are sold to the food industry and that radiation may soon be applied to prolong the keeping qualities of these products. He also forecasts new developments in baked goods within a few years which may have a significant effect on ADM's Commander-Larabee Division, large flour miller.

• • •

To continue its expansion plans to provide additional consulting and testing laboratory services to feed, fertilizer, and insecticide manufacturers, Harris Laboratories, Lincoln, Nebraska, has purchased the Alfalfa Processors Laboratory, Omaha, Nebraska, and will move all equipment to its Lincoln offices. Clients of Alfalfa Processors Laboratory will be provided with the same services at the new address.

. . . Products

The Larvacide Products people are pleased with an unsolicited report on Larvacide recently sent to them by the Badger Safe Protector Co. of Madison, Wisconsin, coming from its Niagara Falls factory. Larvacide is a trademarked product of Larvacide Products, Inc., used in fumigation of stored commodities and in soil fumigation. The Badger company analyzed samples of Larvacide of various ages taken from their glass burglar units. As determined by distillation, all samples had high effectiveness; the sample 32 years old and the one 7 years old were the same – 99.5%, indicating that Larvacide does not deteriorate with age. The manufacturer's comment: "We have been saying for years that Larvacide has tremendous stability."

• • •

A new Entoleter 40-inch Impact Mill (Safety Car Heating and Lighting Co., Inc.) makes available impact velocities in excess of 30,000 feet per minute. This speed is one and a half times as great as that of the 27-inch mill now manufactured, and three times as great as that of the 14-inch mill. The frame will accommodate motors to at least 125 HP in constant-speed type and up to 60 HP with a vari-drive motor. At least twice the capacity of the 27-inch Entoleter Impact Mill can be attained, considering equivalent spindle speeds.

Few data are available showing what the machine will do to a product, but from comparison of impact velocities with those of the smaller units, the 40-inch mill will open up new fields to grinding by impact. It is nicknamed the "Big Inch."

• • •

EMPLOYMENT NOTICES

FOOD CHEMIST

Excellent opportunities – in a financially stable yet growing manufacturing organization – are offered to graduate chemists with extensive research and development experience in the dairy, baking or cereal industries.

Located in metropolitan New York, our progressive company policy provides many employee benefits including life insurance and retirement plan.

Please forward detailed resume of experience, education and salary requirements. All replies confidential. Our employees have been informed of this ad. REPLY BOX 211, American Association of Cereal Chemists, University Farm, St. Paul 1, Minnesota.

Registrants at the 4th Annual Meeting of the American Association of Feed Microscopists, April 9-11, 1956, at Terre Haute, Indiana. Over 75 experts from government, industrial, and academic feed laboratories attended this three day meeting to discuss the latest techniques in feed analysis by use of the microscope. Approximately 15 technical papers were presented on various phases of feed ingredient identification. One of the highlights of the meeting was the Annual Microscopy Workshop. Here members had an opportunity to witness and participate in a number of "live" demonstrations.

STARCH AND STARCH PRODUCTS

STARCH, NOW AND — WHEN?

Another large crop of wheat is being harvested, and another bumper crop of corn is well on its way to maturity. Once more the hands and minds of many men are geared into accelerated motion in diverse directions. Farmers, elevatormen, brokers, millers, and bakers are all moving with renewed activity. The statisticians will again publish astronomical figures about this year's cereal harvest and will probably conclude that we still have a surplus of grain. Quite naturally, men who are concerned with the manufacture and sale of industrial starches, derived primarily from cereals, are much interested in the annual harvest of cereal crops and in what might be done to utilize surpluses.

Let's look at a few starch statistics for the United States. During the past 25 years, utilization of starch has expanded from 800 million pounds to 2.4 billion pounds. The past decade has seen approximately a fourfold expansion in the use of corn starch in the paper industry, which presently consumes over 700 million pounds of starch per year. The textile industry puts about 300 million pounds per year into new cloth, whereas about 150 million pounds goes into the older in laundries, both home and commercial. Other important industrial outlets for starch are in the refining of aluminum and iron ores, in oil-well drilling muds, in the manufacture of asbestos sheets and gypsum board, in dry cell batteries, as a core binder in foundry operations, and as a binding agent in pharmaceutical tablets. This may seem like a tremendous amount of starch consumed annually by industry, but it represents only about 5% of the total corn produced and a much lower percentage of the yearly wheat harvest.

As a result, the starch industry as such is actively searching for entirely new areas of application for starch. For example, with the ever-increasing rate of automobile travel in this country there is a great demand for bigger and better highways: might there not be a place for starch in highway construction? With our increasing population, could not more starch be used in materials for home-building? Besides the need of new outlets, however, present starch products need constant improvement so they will not become obsolete in the face of competitive materials.

The solutions to these problems lie in more and more research. Many new applications for starch arose from the discovery that starch contains two distinct molecular components, namely, amylose (straight chain polymer) and amylopectin (branched chain polymer). The work of the geneticists and plant breeders eventually brought the waxy maize and waxy sorghum types (100% amylopectin

Quality is always remembered

. . . AND QUALITY IS A LONG ESTABLISHED TRADITION WITH WILBUR-SUCHARD CHOCOLATE

For three generations, manufacturers have recognized the uniformity and superior quality of Wilbur-Suchard Chocolate Products. They are tailor-made for the baking and confection industries . . . unsurpassed for coatings or mixes of all kinds.

If you use chocolate or cocoa in your business, it will pay you to write or phone us for samples and quotations. Our laboratory will gladly work with you in the solution of any problems or the development of new products.

CLINT CREGIER, Representing
WILBUR-SUCHARD CHOCOLATE CO., INC.
8747 St. Louis Ave., Skokie, Illinois

starch) into commercial production. The waxy type of starch has superior properties when used as an oil-well drilling additive, or as an ingredient in instant pudding mixes, or in many frozen food preparations. A great amount of research has failed as yet to uncover a waxy wheat. Perhaps it still will be found. Great progress is being made in producing genetically a corn with very high amylose content. When this is accomplished, new applications for starch should come upon the scene. For instance, the amylose type of starch, with its superior film-forming properties, could conceivably find a place in the packaging field.

Starch granules themselves present many still unsolved problems. How important is granule size in many applications? What is the real difference between the small and large granules of wheat starch? When will a granule similar to that produced in nature be made by man in the laboratory? When will it be commercially feasible to manufacture amylose or amylopectin by means of enzymes? When starch is cooked in water, how important in specific application are the granule fragments, as compared to the molecular systems of amylose and amylopectin? How do granules of different starches differ in their chemical reactions with other substances?

The comparatively recent work of extracting starch derivatives chemically for particular application is just a beginning. Cereal starches can now be made with pasting properties similar to those of the root starches, by reaction with ethylene oxide to form hydroxyethyl ether derivatives. The years ahead will undoubtedly see many more and varied derivatives.

The organic chemicals of today in general are derived from natural gas, petroleum, coal, and agricultural products. Our reserves of the first three are diminishing at a fairly steady rate, whereas most agricultural products are renewed annually. In another 25 years with an estimated population of 222 million, compared to 150 million in 1950, the chemical industry may have to turn to agricultural materials, principally cereals. At the same time, with more mouths to feed, and with a definite limitation on the total crop-land area suitable for agricultural production, there may very well be a day of no surpluses.

F. E. HORAN

A.A.C.C.

LOCAL SECTIONS

The Annual one day joint conference between the AACC's Toronto and Niagara Frontier Sections and the Association of Operative Millers will be held in Toronto, Saturday, October 13, at the Royal York Hotel. Speakers and program details will be announced at a later date.

• • • •

The Lone Star Section met July 21 in Fort Worth, Texas with the following program: "Report of Development and Activities of Texas Experiment Stations"—Dale E. Weibel; "Civilian Defense and What It Means to Us" —representative from U.S.C.D.A.; "Report of New Crop Committee and General Discussion of New Crop"—C. T. Newell.

• • • •

A two day meeting of the Pioneer Section was held August 10 and 11 at Enid, Oklahoma. The new crop was reported by: Ralph B. Potts, Farinograph; Eldon Smurr, Sedimentation and Viscosity; Lawrence Iliff, analytical characteristics relative to Protein, Ash, and Moisture; John Giertz, Malting Requirements; Jim Doty, Oxidation — Bleaching Requirements; George Shiller, Extensograph; Lester Fisher, Baking Characteristics. Mr. Howard Becker, Nebraska Consolidated Flour Mills, reported on the 1956 Nebraska wheat crop and Dr. Elmer Heyne, Kansas State College, discussed the climatic factors that affected the 1956 wheat crop.

• • • •

The Northwest Section will have a noon luncheon meeting at Dayton's on Friday, September 28. Speaker will be Prof. Gayle McElrath of the Industrial Engineering Department, University of Minnesota. Mr. McElrath is widely known as a leader in developing applications of statistical techniques to industrial problems, particularly in the field of quality control.

• • •

NOTE: Section chairmen are again reminded that all meeting notices or advance program schedules for the coming year should sent to the AACC headquarters as soon as they are available.

R. J. TARLETON

KEL-PAK
powders

● The use of Kel-Pak Powders will allow you to run nitrogen determinations in less time, with greater accuracy, and at a lower cost.

● Five standard formulas are available. All conform to A.O.A.C. standard methods.

● Write for bulletin and prices.

KANSAS CITY
Laboratory Supply Co.

307 Westport Road Kansas City 11, Missouri

Telephone JEfferson 1-7745

Observations

With the tremendous quantity of grain in storage in the United States today, it appears to us that cereal chemists should be giving more consideration to studies of causes of grain deterioration in storage.

The work of Clyde M. Christensen, Professor Plant Pathology, University of Minnesota, on moisture content, molds, and "sick" wheat presented in the June issue of "Grain Magazine" points the way for some collaborative studies of methods for determining the mold content of grain. We need to know considerably more about the mold, moisture, and time-temperature ratios so that we can intelligently advise our employers of the stability of any given lot of grain at any stage in storage. According to Dr. Christensen's review, it seems entirely possible to determine ahead of time when grain is likely to go bad in storage. Particularly is this true with wheat that may have germ-damage and thus is called "sick" wheat. His presentation indicates that methods are available for determining the mold beneath the bran of wheat; it is this mold that gives rise to "sick" wheat.

A collaborative study of the methods outlined should prove very valuable to all cereal chemists, particularly if definite information could be evolved as to when grain should be turned, how the molds can be inhibited, etc. This rather brief observation is presented in the hope that A.A.C.C. members will evaluate the merits of study along these lines.

Jim Doty

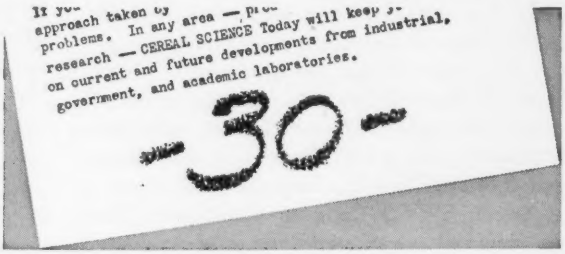
DOTY Technical Laboratories

P.O. Box 2689, Kansas City 42, Mo.

MILLING FEED ANALYSIS

VITAMIN ASSAYS

BAKING SANITATION


research — CEREAL SCIENCE Today will keep
on current and future developments from industrial,
government, and academic laboratories.
-30-

MORE CONTEST

A unique attraction at the A.A.C.C. meeting in New York was a Cake Scoring Contest sponsored by the Prepared Mix Committee. Nine cakes consisting of three white, three yellow and three devils-food were cut in half. The resulting 18 halves were individually identified by letters and displayed in random order on a rack.

The participants indicated on a score sheet which two half-layers appeared to have been cut from the same cake. Slight differences in grain and texture had been produced by such formula modifications as the addition of 0.15% soda in one, and an increase of 4% water in the other. The participants were merely allowed to view the cakes — not feel or taste them.

Paul Holton, Chairman of the Consumer Mix Subcommittee, rewarded the individuals having perfect scores, with Certificates of Merit, such as the one reproduced below.

The 57 winners of this Certificate were:

Arlee A. Andre, John Andrews, Robert Baeuerlen, R. A. Barackman, A. F. Borer, Jerry Chawes, Howard A. Clark, Allan N. Cohan, Louis N. Cohan, Clint Cregier, Lloyd Crossland, Sylvan Eisenberg, Vernon I. Eklund, James W. Evans, Jean M. Fanning, V. E. Fisher, Francis M. Franco, George Garnatz, Max Goldfrank, Pauline F. Goldman, W. J. Griebstein, Frederick C. Heitman, John T. Henningsen, Sigmund Hoffman, C. M. Hollenbeck, Robert P. Langguth, R. A. Larsen, John E. Lawler, R. F. Light, Derek D. Lord, Andy Maren, Charles N. Marvin, Paul P. Merritt, G. Moen, Jack W. Monier, Robert F. Murphy, Serge Oliel, O. A. Oudal, Grant W. Pearcy, Steven W. Plotycia, Del Pratt, W. W. Prouty, Joseph Radov, J. V. Reger, William Schroeder, Glenn S. Schulman, F. R. Schwain, M. Doreen Smith, Robert Stapf, J. A. Thorn, E. A. Vaupel, Isobel Walker, Ernest Washburn, Frank W. Wichser, John P. Wolcott, Harold E. Yoder, and F. P. Zscheile.

OUR COVER

To clear up any doubt that may exist in the reader's mind, the cover subject is symbolic only. It represents not *a* machine, but machines in general. The artist, an Associate Professor of Art at the University of Minnesota, states that he used no one machine as a model. Instead he tried to depict a composite machine, a colossus, overpowering man. We think it resembles an aged combine. What do you think?

Incidentally, the sculpture is a 14½-inch-high bronze cast, and was shown at the 1956 Biennial of Paintings, Sculpture, and Prints from the Upper Midwest, at Walker Art Center in Minneapolis. This work represents one of the many fine art objects available for sale or rental to residents in this area.

LETTERS TO THE EDITOR

There are few editors that do not appreciate receiving mail from their readers, either criticism or praise. A letter to the editor indicates the publication is being read, regardless of how "throat-stomping" the contents. This writer is no exception. We try very hard to have at least one item in each issue of interest to everyone. If we're missing the boat we'd like to know about it. Drop us a line letting us know what *you* think. We'll try and publish as many communications as space permits.

NEXT MONTH

Manuscripts from the New York AACC meeting are now starting to come through and we'll publish the first in October. Also, make a note to check the Technical Section for an excellent paper on wheat conditioning written by G. H. Sugden of Henry Simon, Ltd. For those interested in enrichment, D. W. Kent-Jones will review the "Cohen Report", just received from England.